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THE AMERICAN ARCHITECT AND BUILDING NEWS

VOL. XXI. REGULAR EDITION NO. 583.

ARCHITECTURE

ENGINEERING

DECORATION

CONSTRUCTION

TICKNOR & COMPANY

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First Parish Church, Meeting-house Hill, Dorchester, Mass.
[Gelatine Print issued only with Gelatine and Imperial editions.]
Railway Stations at Wellesley Hills, Waban, Woodland, Auburndale, Brighton, South Framingham, Palmer, Holyoke, and N. Easton, Mass.
Minot's Ledge Light-house, Boston Harbor, Mass.
House at Binghamton, N. Y.

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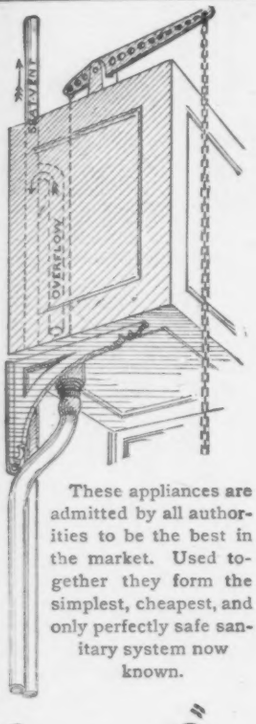

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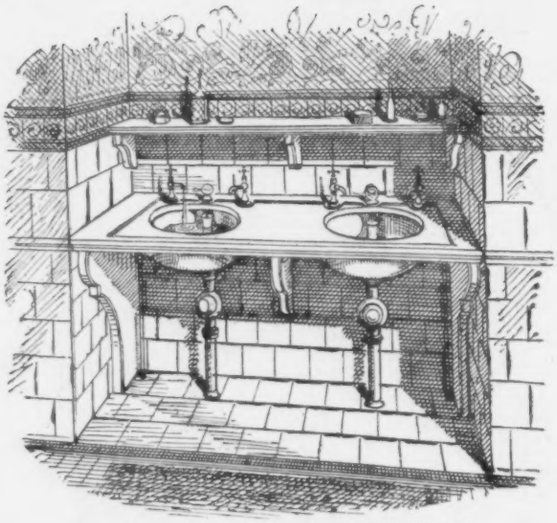

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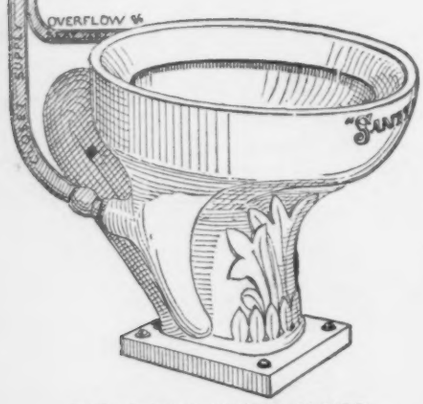

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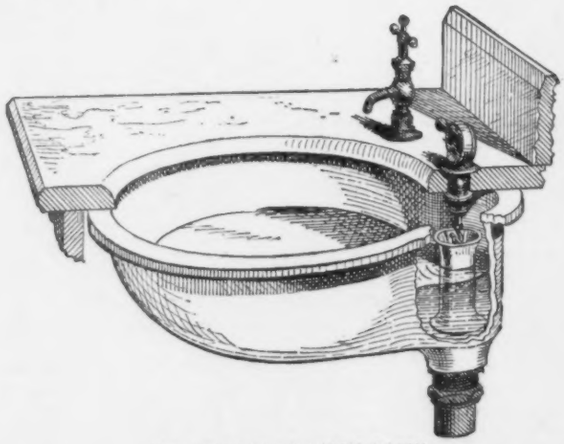

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THE *Investigator*, one of the oldest and best insurance journals, publishes an editorial warning underwriters against insuring churches. Although it acknowledges that the "moral hazard," by which underwriters mean the probability that a building will be set on fire to get the insurance-money, hardly exists at all in connection with churches, "the fact remains," as it says, "that churches are among the worst risks in the business," and it advises its readers to let them alone. The reasons which it gives for the existence of a particularly combustible disposition among church buildings are rather amusing, not only as involving a well-deserved criticism of the methods too often employed in church construction, but as expressing, quite unconsciously, the indulgent contempt which a business man is rather apt to feel for church management. As the average loss for each church burned is something over nine thousand dollars, it is evident that the more costly structures are quite as subject to fires as the cheap ones; and the *Investigator* finds the principal reason for this to consist in the anxiety of the builders of churches "to make the extreme limit of external show," securing their end by means of "lath and plaster shams" in place of solid work. To the hazard of cheap and false construction is, moreover, usually added a still worse one, in the shape of a tower, or spire, "to catch and hold any sparks that are in the neighborhood at heights beyond the reach of the ordinary fire-extinguishing facilities;" and the whole inflammable structure is kept in jeopardy by the special qualities of the heating-apparatus generally placed in it. This heating-apparatus is commonly made very large, "so as to give out a great quantity of heat in a short time," and, when put in action, it is required to warm, in a few hours, to a comfortable point, a large building, almost always thinly and poorly constructed, which has been left cold for nearly a week. The person who takes care of the church fires, and who, as the *Investigator* uncharitably says, "is usually some one who has not had enough gumption to make his living in the ordinary vocations of life," crowds the furnaces to their utmost capacity; the flues and pipes, after having been kept a week at a temperature not far removed from freezing, are violently expanded, and the weaker points yield, finally forming a crack, through which comes, sooner or later, a fatal spark.

THE *Wiener Bauindustrie-Zeitung* quotes at length a set of rules for the construction of stoves, and for kindling and maintaining fires, which have recently been published by the Town Council of Dresden, for distribution among the citizens. Most German, Swiss and Dutch houses are warmed in winter by means of stoves, which are sometimes of small size, for heating single rooms, sometimes large enough to heat two rooms, between which they are placed, but in either case are usually built of brick, or of enamelled tiles. In many instances, particularly in hotels, the stove is placed at the intersection of the partition between two rooms with the wall of a corridor or hall, in such a way that the servants can feed and attend to it from the hall, while it distributes its heat between the two rooms. For such purposes the affair must be of considerable size, and, as the flues in German chimneys are almost always very small, four inches by eight, for instance, being a common size, it is important that the fire should burn evenly and well; and the Dresden rules are the product of a good deal of observation of stoves in which this end is not attained.

THE most important rule in arranging the dimensions of the stove or furnace is to have the grate smaller in diameter than either the ash-pit or the fire-pot, both of which should expand, like an hour-glass, away from the grate. The grate itself is required to have bars so near together that the coal to be used will not fall between them, but no further directions are given in regard to it; and it would seem that our familiar anti-clinker grates, which can be shaken or rocked from the outside, without allowing ashes to escape into the room, must be unknown in Germany. The front portion of the grate, according to the rules, is to be occupied by a plate of iron or fire-clay, sloping upward from the grate to the bottom of the fire-door, in the same way as the "dead plate" occasionally used here in setting boilers; and, finally, the doors, both of the fire-pot and the ash-pit, are required to shut close, and to have registers for controlling the admission of air through them.

BEFORE kindling a fire in the stove so constructed, all remains of previous fires, according to the rules, must be cleaned away, leaving the grate clean. Fresh coal, dry and free from dirt, is then to be piled up at the back of the grate, occupying about two-thirds of its area, and in front of this is to be placed kindling-wood, mixed with small lumps of coal. The wood is then to be lighted, and the upper door closed, leaving the ash-pit door wide open. At this stage of the proceeding it is important to keep the kindling-wood in active combustion, in order that heat enough may be developed to ignite the coal; and the opening of the upper door, either to see how the fire is getting on, or with the idea of admitting more air, checks the burning of the wood as well as the draught of the chimney, and cools off the fire-pot, which, when heated by radiation from the blazing wood, aids greatly in raising the temperature of the coal. If, in spite of these precautions, the kindlings should partially fail of their effect, and burn nearly out before inflaming the coal, the lower door must be cautiously shut, so as to cut off a part of the supply of air, which is now too great for the combustion to be supported by it, and cools and deadens the feeble fire; and by careful nursing in this way it may be possible to revive an almost expiring flame, and encourage it into the activity desired. In either case, after the heap of coal at the back of the grate has become well kindled, it should be drawn forward with a poker or slice-bar, and spread evenly over the grate. The fire is then to be watched through the ash-pit. So long as the fire radiates a red light through the grate, uniformly over the bottom of the ash-pit, all is going well: but a shadow, or the eclipse of a portion of the shining area of the grate, shows the presence of some obstruction to the draught, which should be promptly removed, by opening the upper door, and raking the fire, shaking down through the grate the ashes which may have caused the eclipse; or pulling out clinkers with poker and tongs, or breaking up the lumps which often form by the melting of bituminous coal, and which can sometimes be avoided by mixing coal of this sort with coke or coal of a harder kind.

IN all cases the ash-pit must be watched, to see that it does not get too full of ashes. The rule is, that as soon as it is half full, it should be cleared out; and any accumulation beyond this point checks the fire, by cutting off the access of air, while it endangers the grate itself, which, no longer cooled by the free passage of air through it, and exposed to the reverberation of the hot ashes close below, often melts so much as to lose its shape, even if it is not entirely destroyed. If the fire gets low, and it is desired to revive it, fresh coal should never be thrown directly upon the remains of the old fire. If

the slackening of the combustion has been caused, as will often be the case where the attendance has been remiss or not intelligent, by an accumulation of ashes or clinkers, cutting off the air-supply, the addition of fresh coal will add to the evil, by producing an irregular, smoky and wasteful fire, which tends to melt the ashes or clinkers already present, increasing the trouble which they cause, and often incrusting the grate or the fire-pot lining with a hard mass, which it is almost impossible to remove; while, if the fire has been kept clear, but has burned low for lack of fuel, the addition of cold, fresh coal abstracts so much of the small store of heat which still remains as often to put the fire out altogether. Instead, therefore, of putting the new coal on top of the old, the smouldering fire should be cleared of ashes, and the live coal pushed back to the rear portion of the grate, leaving the front portion, for about one-third of its area, entirely free. The fresh coal is then to be placed on this part of the grate, and on the sloping dead-plate, and the upper door closed. As the pieces of coal nearest the fire become heated and decompose, the gases which they evolve pass over the live coals on their way to the flue, and their ignition begins immediately to warm the fire-pot and kindle the rest of the fuel, and when the whole has begun to burn, it is only necessary to spread it uniformly over the grate. Much of this good advice is with us applicable to the care of boiler furnaces, rather than house stoves, which our manufacturers make either self-feeding or in some other way so automatic as to need little care or attention; but the principles laid down are excellent, and we might, perhaps, afford, in gratitude for instructions which, if followed, would save owners of steam-boilers many dollars, to send back in exchange to Germany a few samples of those strong and convenient cast-iron stoves which our foundries make so cheaply and so well.

ALL accounts show that a revival of business is taking place all over the world, and unless some great war comes to destroy property and disturb commercial relations, the next year seems likely to be a pleasant one for all those who make their money by the prosperity of other people, and not by their misfortunes. The price of iron, which, as an index to activity in construction, is usually regarded as the barometer of business prosperity, has risen everywhere. In England, as we learn from *Le Génie Civil*, pig-iron has advanced nine shillings a ton, or about thirty per cent, and even at this advance a single order of ten thousand tons has been sent to Middlesbrough from a foundry in St. Louis, which finds it better to buy English iron, bring it by sea from Middlesbrough to New Orleans, pay a heavy duty upon it, and then have it transferred to river-boats for transportation to St. Louis, than to use American iron, the cost of which, delivered at the foundry, would be only five or six per cent less than that of the foreign material. In Belgium, which has of late years been deeply sunk in labor troubles and business depression, iron, as well as the coal needed for working it, have risen materially. Even at present prices, however, it is rather tantalizing to see iron I-beams, which we do not consider dear here at three cents a pound, quoted at Charleroi at one cent; while rails, the price of which in Europe is not very different from that of rolled beams, can be had here for about half as much as is charged for the material of construction which it is so desirable to bring into extensive use. In Germany, thanks to extensive orders from Brazil and the Argentine Republic, as well as from the United States, the rolling-mills and foundries are in active operation, and prices have risen in proportion to the increased demand.

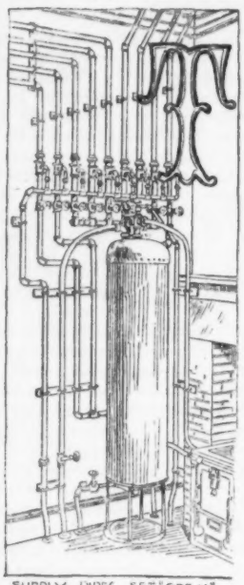
WE regret very much to learn from the *Building World* that Mr. Jonathan Carr, the founder of the famous suburban village of Bedford Park, near London, has fallen into financial misfortune, with, however, a possibility, which we trust may improve into a certainty, of being able to meet his pressing liabilities, and to save a small remnant out of the great property which he once held. In many respects, Mr. Carr is one of the best and most favorably known men in England. If we are not mistaken, he is a brother of Mr. Comyn Carr, a distinguished critic, and, although engaged in important business affairs, has always taken special pleasure in associating himself with that artistic movement which seems likely to do so much for England. Some fifteen years ago, a large estate in the vicinity of London, which had originally been the park attached to one of the castles of the Dukes of Bedford, was put in the market, and Mr. Carr, who was then a very rich man, appreciating the advantages which would result from keeping it under one control, and laying it out and building upon it in accordance with a scheme devised to preserve as far as possible its natural beauty, took the resolution of buying the whole estate. Having made this acquisition, he employed the best landscape gardeners to lay it out for building upon it, and applied to Mr. Norman Shaw, Mr. Edis, Mr. E. W. Godwin, and one or two more of the English architects best known for their success in domestic architecture of the picturesque sort, to design for him a variety of dwelling-houses, modest in dimensions, but full of distinction and artistic style, and so grouped as to retain so far as possible the natural beauty of the old park. The labors of the architects were seconded by Mr. William Morris, who decorated the houses with those matchless furnishings which have made his name famous all over the world, and tenants and purchasers were then invited to choose among them. The deeds and leases contained restrictions as to the occupancy of the houses, intended to secure perpetual immunity from the annoyances of manufacturing or mercantile business in the neighborhood of the village, and lots were set apart, upon which were constructed a church, and a club-house containing reading and reception rooms, for the use of the residents and their families. It was not long before the advantages of living in such a neighborhood began to be appreciated, and hundreds of people applied for the privilege of enrolling themselves among the inhabitants of Bedford Park. Mr. Carr himself built a beautiful house in the midst, and it seemed certain that he would reap a large profit from his undertaking, at the same time that he gave pleasure to a great many people of cultivated taste. What may have been the circumstances which led him into loss instead of profit we cannot say, this part of the history of Bedford Park not having yet been made public; but early in the winter the originator of the whole scheme was petitioned against in the bankruptcy court, by creditors exhibiting claims to the amount of seven hundred and fifty thousand dollars. Most of the creditors were secured by mortgages on houses and other parcels of real estate; and at the time referred to in the *Building World's* account it was hoped that the rents would keep the interest on the secured debts paid, leaving enough surplus to meet the unsecured obligations, and finally, to pay off everything in full.

ANOTHER grief has been added to the woes of the lovers of picturesque nature by the announcement that a concession has been granted for the construction of a railway from Visp to Zermatt, where now only a bridle-path, and that not a very good one, serves for communication. Zermatt, as every one knows, is the favorite starting-point for those people who like to risk their lives on the Matterhorn and Monte Rosa, and consists of a small, cold valley, five thousand feet above the sea, surrounded by mountains covered with snow and ice. Notwithstanding its chilliness, and the difficulty of getting to it, Zermattis visited by about twelve thousand persons every summer; and it is calculated that if this number should be increased to fifteen thousand, by the improved facilities which the railroad would give, that the enterprise would bring a good interest on its cost. Like most of the mountain railways now under way in Switzerland, the Visp-Zermatt line is to be of narrow guage, with a third toothed-rail in the steepest section, where the grade is one hundred and fifty feet in one thousand. The concession limits the time within which the road must be completed to two years and a half from the time that the engineer's plans are accepted, and fixes also the price of transportation, which is to be sixteen francs from Visp to Zermatt, for first-class passengers, and ten francs for second-class. Near by is to be built another mountain road, for which the plans are now under consideration, extending from Brieg, by the Rhone glacier, to Airolo, at the south end of the St. Gothard tunnel, bringing into direct communication the Italian railway system, and the great Swiss and German system, which centres at Lucerne, with the roads of southeastern Switzerland and southern and central France.

A CORRESPONDENT of the *Deutsche Bauzeitung* corrects the prevalent idea that the chimney of the Mechernich lead-works is the highest in the world. Although this is higher than the chimney of the St. Rollox Chemical-Works at Glasgow, it is considerably surpassed by another in Glasgow, that of the Port Dundas Chemical-Works, which rises to the height of four hundred and fifty-four feet above the ground.

THE WATER-SUPPLY OF BUILDINGS.[1]—II.

GENERAL ARRANGEMENT OF THE PIPING.



SUPPLY PIPES SET "OPEN"

THE entire system of supply-piping should be exposed to full view. Nothing should be inaccessibly encased behind panelling, or buried beneath floor boards or plastering. Well executed and brightly polished and lacquered piping may always be made ornamental. In the principal rooms and main hall, hinged and panelled doors may be used in front of the pipes if necessary, and the exercise of a little taste and ingenuity on the part of the architect will render these ornamental features in the design. As a rule, however, it will be found possible to avoid carrying the pipes through these rooms.

Although there is really no sound practical objection to this entire exposure of the piping throughout a house, it is nevertheless very seldom carried out, and the careful owner is obliged to apply to the architect for a "piping-plan" for reference, in case of repairs. This plan is, however, usually so carefully stowed away by its anxious guardian, that he is seldom able to lay hands upon it again, after the lapse of years, when it is needed, and a widespread devastation of the floors and plaster by the ruthless plumber is the result.

For the purpose of avoiding the possibility of such a loss, it has been lately recommended to have the plan painted in oil color on the inner panels of some convenient closet door. Others again advise painting lines of color, indicative of the various kinds of pipes, red for hot-water and blue for cold, on the upper floors over the pipes themselves. Either of these methods of indication would indeed ensure the owner against misplacement; but no map yet devised could point out a leak, or facilitate the execution of a repair on buried piping.

All trouble would be avoided and better work obtained by having the pipes themselves form their own plan. Equally important with an open-setting of the pipes, is their arrangement in such a manner that they shall thoroughly drain themselves when the supply is shut off, so that when the building is to be left unoccupied for any length of time, there may be no danger of accident from freezing.

All horizontal lines of soft-metal pipes, moreover, should have a *continuous* support, since otherwise they will sag under the influence of expansion and contraction, and form a series of running traps. Expansion will evidently cause a bagging between the supports. Subsequent contraction cannot restore the pipe to its former position, because the weight of the material overcomes the cohesion of its particles, and it is easier for it to stretch than to lift its sagged portion back into line. This is forcibly illustrated by the creeping of lead sheets used in roofing. Figure 1 gives an illustration of the condition of a pipe subjected to alternating temperatures after several years of use. Such a pipe could never be drained, and would burst if exposed to frost. Instead of the tacks, a continuous strip of wood should be used for support.

Fig. 1.

When a house is closed, or left for the winter, it is not sufficient merely to shut off the main street supply at the cellar wall, but the entire pipe system must be completely drained. This will be extremely easy if the work has been properly executed, but impossible if it has not. The rising main may be emptied either through a special draw-off faucet, or through the small waste-hole of the main stop-and-waste cock. All branches should drain back into the main supply. Otherwise it will be necessary to turn open their faucets.

The down-pipes from the main tank should then be emptied by opening the lowest faucets; the tank itself, by means of its large blow-off pipe, and not through the descending service-pipes, to avoid choking them with sediment.

Another important general principle is that all pipes should, as far as possible, be protected from frost. Exposed corners, outer walls, and places which cannot readily be heated in winter, should be avoided. Where, however, it becomes necessary to run them along an outer or exposed wall, the pipes should not be placed directly in contact with such wall, but should be fitted on small strips or shelves of wood nailed to the masonry, or even packed with some non-absorbent, non-combustible material, such as felt, asbestos, or mineral wool. Pipes are much less likely, as a general rule, to suffer from frost, when they are set open and accessible to the warm air circulating about the house, than when they are concealed behind the furring or between the joists, against the cold walls and interspaces of the framing. A proper placing and protection of pipes from frost is probably the best preventive of water-waste. The pernicious habit of leaving water running during the night, and in "cold snaps" of weather even during the daytime, would be much less common if proper precautions were taken in setting; and no better means of protecting the public against this selfish wastefulness could be devised in unmetered houses, than to require the pipes to be set open, and where they pass through cold places to be jacketed. The expense to the owner of thorough jacketing would ensure the proper running of the pipes in the warmest places. Mr. James C. Bayles says in his "*House Drainage and Water Service*": "During, and immediately after a 'cold snap' in January or February, our streets present a curious appearance. At frequent intervals we see groups of laborers tearing up the pavement, or building bonfires to thaw the ground enough to permit them to expose the buried pipes. During the winter of 1874 I saw as many as a dozen such groups on one block in the upper part of New York, and while the effect upon the eye was picturesque, the effect upon those compelled to pay over and over again for the same work, which never should have been necessary in the first instance, was not all that could be desired. Probably we shall see the same thing every cold winter, for years to come, and while the public misfortune will bring profit to the plumbers, it will not benefit the trade in the long run. . . . The inconvenience suffered, great as it may be, is of small consequence compared to the danger of sewer-gas poisoning, especially in the absence of adequate soil-pipe ventilation, and the nuisance resulting from the accumulation of foul matter in water-closets."

THE MAIN HOUSE-TANK AND ITS PIPING.

Mr. Bayles also rightly says: "To so arrange the service-pipe system in a house that, so long as the average pressure is maintained in the street mains, or main supply-pipe, we shall have a constant flow, if desired, at any and every cock and closet valve, is one of the refinements of the plumber's art, which does not come within the knowledge of a majority of those who claim to know their trades. Certainly it is a desideratum for which comparatively few architects know how to provide without adding greatly to the cost of the plumbing work in a house."

It is therefore important both that our system of piping should be reduced to the utmost possible simplicity, consistent with convenience and safety, and that its philosophy should be explained in the simplest manner.

Beginning with the house-tank and its piping, the following rules are always to be observed as of vital importance.

(1) Excepting under peculiar conditions, hereafter to be considered, the drinking and cooking water should be drawn from the main supply-pipe leading to the tank.

(2) All water used for water-closet flushing and for lavatories and boiler-supply, should be taken from the tank or its down-pipe.

(3) The pipes should be so graded in size as to give a constant supply at every story to which the pressure would raise it, irrespective of what is drawn in stories below.

(4) The main tank should be placed at the highest point in the building, at which a sufficient daily supply of water can be assured.

(5) All water-closets below the main house-tank should be supplied immediately from it. All above the main tank should be supplied from special cisterns of their own.

The water is brought to city houses from the street-main, through a pipe whose size is limited by the water companies. We will assume it to be five-eighths of an inch in diameter, for

Continued from page 40, No. 578.

our present illustration. At the end of this pipe, just within the cellar wall, should be provided a stop-and-waste cock. From this point it should be enlarged considerably, for the purpose of avoiding friction, since, with a given size of pipe at the cellar wall, a much larger quantity of water can evidently be obtained in a house in a given time through a large than through a small system of piping.

We will start, then, with an enlargement to one and one-half or one and one-fourth inches, according to the number of fixtures in the house to be supplied, and carry the pipe of this size through the cellar and basement, and up to the top of the kitchen boiler. All branches taken from this run of pipe to the various kitchen and laundry lavatories will be from one-half inch to one inch in diameter, according to the number and kind of fixtures to be supplied. Where iron supply-pipe is used special sizes will be given for this material hereafter.

From the boiler, the diameter of our main should be reduced, say a quarter of an inch, or to one and one-quarter inches or one inch again, according to the number of fixtures to be supplied; and it should continue of this size, up through one or two stories, as may be required, the branches ranging from one inch to one-half inch as before.

A further reduction should be made as the main ascends, until it reaches the tank, where it need not exceed one-half or five-eighths of an inch in diameter. In short, this pipe system should be constructed on the principle of the trunk and branches of a tree which has to supply sap to its leaves and blossoms. At every branch or twig a diminution of size occurs in proportion to its bulk, and each leaf and blossom obtains its full supply of nourishment at all times, independently of the rest.

The distribution of hot-water may be similarly planned, as will be described under the heading of "Hot-Water Circulation." This method of piping is little or no more expensive than the usual one.

To carry out our second rule, we pursue the same system; All the water-closets in the house should be supplied directly from the down-pipe from the main tank, without the intervention of special cisterns. There is no advantage in complicating the work by the use of these small cisterns, with all their paraphernalia. By doing away with them, we save, in the first place, the cost and chance of leakage of each cistern ball-cock, of the cistern itself, with its valve mechanism, brackets, etc., and of the supply and overflow pipes from cistern to water-closet; and, secondly, we would save the expensive wooden cistern casing, and the space in the room occupied by it and its fittings. We should avoid, also, the disagreeable noise of the water entering the cistern from its ball-cock, and the open bodies of water standing in the cisterns, which, by evaporation, create a dampness in the house, often very undesirable.

The improved modern water-closet requires, for proper flushing, a rapid water-supply. Hence the down-pipe from the tank should be large enough to furnish the volume of water required very quickly, and a pipe two inches in diameter will not be too large at the top. It may diminish as it descends to the basement, and as the lateral branches are taken off. The size of the branches should be regulated by the distance of each closet from the down pipe, as well as by the water-head in each story, and should vary between two inches and one inch, according to circumstances, and, for the sake of economy, the down-pipe should be made of iron properly protected from rust.

Each water-closet should have under its seat a simple valve, at the end of the branch-pipe, for flushing.

The reason why this economical system of water-closet supply has not heretofore been generally adopted, is because of the difficulty of constructing a cheap and reliable valve, which should deliver quickly a suitable volume of water, under the highest as well as the lowest pressure involved, and which should close automatically, without noise or concussion.

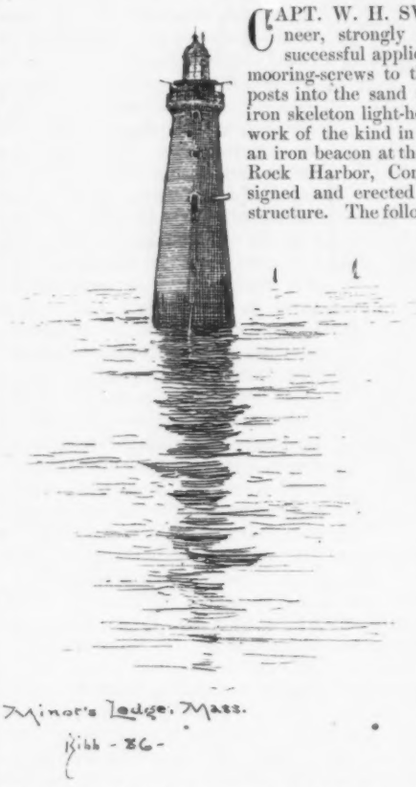
J. P. Putnam.

[To be continued.]

Education in Art in St. Louis.—An odd incident shows that education in art is still needed in St. Louis. The great library of that city is preparing for removal, and a sale of pictures took place. At the sale a bronze reproduction of the Venus of Milo, which cost $1,700, was sold as a "fixture" for $5, by one of the directors, whose art education had possibly been less thorough than his business training. Fortunately, the librarian rescued the Venus before the sale was completed.—*Boston Journal.*

ANCIENT AND MODERN LIGHT-HOUSES.[1]—IX.

MINOT'S LEDGE LIGHT-HOUSE.



Capt. W. H. Swift, U. S. Engineer, strongly impressed by the successful application of Mitchell's mooring-screws to the forcing of iron posts into the sand as a framework to iron skeleton light-houses, built the first work of the kind in the United States: an iron beacon at the entrance of Black Rock Harbor, Conn. He then designed and erected a more important structure. The following account is taken from his official report (November, 1848).

"Minot's Rocks—or as they are more generally called 'The Minots,'—lie off the south-eastern chop of Boston Bay. These rocks or ledges, with others in their immediate vicinity, are also known as the 'Cohasset Rocks,' and have been the terror of mariners for a long period of years; they have been, probably, the cause of a greater number of wrecks than any other ledges or reefs upon the coast, lying as they do at the very entrance to the second city of the United States in point of tonnage, and consequently where vessels are constantly passing and repassing. The Minots are bare only at three-quarters ebb, and vessels bound in with the wind heavy at north-east, are liable, if they fall to the leeward of Boston light, to be driven upon these reefs. The rock selected for the site of the light-house is called the 'Outer Minot,' and is the most seaward of the group. At extreme low water an area of about thirty feet in diameter is exposed, and the highest point in the rock is about three feet and a half above the line of low water. It is very rarely, however, that a surface greater than twenty-five feet in diameter is left bare by the sea. The rock is granite, with vertical seams of trap rising through it. The form of the light-house is an octagon, twenty-five feet in diameter at the base. The structure is supported on nine heavy wrought-iron piles, one at each corner of the octagon, and one at the centre; holes twelve inches in diameter, and five feet deep were drilled in the rock to receive these piles; the outer holes at such an inclination that at an elevation of sixty feet above the base of the middle pile, the pile-heads would be brought within the periphery of a circle fourteen feet in diameter. The centre pile was eight inches in diameter at the bottom, and six inches at top; the other piles have the same diameter, eight inches, at the bottom, and four-and-a-half inches at the top; at their upper ends they are securely keyed and bolted to the arms of a heavy casting or cap. It is understood that the foundation piles do not extend the whole sixty feet; but that there are in all three series of piles joined to each other by very stout cast-iron sockets and strongly braced."

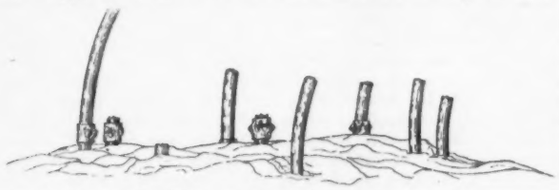
In that exposed situation, where the sea was so constantly breaking over the rock, the drilling of holes of the required size could only be done by machinery raised above the reach of the sea. This operation consumed the greater part of two seasons. The erection of the tower was less difficult. The work commenced in 1847, was finished in November, 1848. Next year, in order to stiffen the piles, and to prevent in as great a degree as possible the tendency to vibration, there was introduced a series of wrought-iron vertical tie-rods between the first and second series of braces. It was intended to place another series of these ties between the foot of the piles at the rocks, and the first or lower series of horizontal braces. This structure was carried away in April, 1851. Captain Swift reported as follows: "On Monday night, April 14, the wind, which had been easterly for several days, gradually increased. On Tuesday it had become a severe gale from the northeast. It continued to blow with the utmost violence through Tuesday night, Wednesday, Thursday, and even Friday; but the height of the storm was on Wednesday, the 16th, and at that time it was a perfect hurricane.

"The light on the Minot was last seen from Cohasset, on Wednesday night at 10 o'clock; at 1 o'clock, Thursday morning the 17th,

[1] Continued from No. 582, page 93.

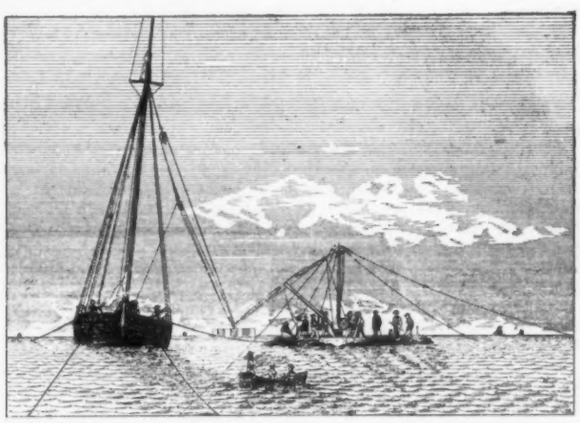
the light-house bell was heard on shore, one-and-one-half miles distant; and this being the hour of high water, or rather the turn of the tide, when from the opposition of the wind and the tide it is supposed that the sea was at its very highest mark; and it was at that hour, it is generally believed, that the light-house was destroyed; at daylight nothing of it was visible from shore, and hence it is most probable it was overthrown at or about the hour named."

The appearance of the site when it was visited on April 22d, is



shown in the sketch. The portion of the wreck of the structure was found one hundred feet from the site.

The second series of horizontal braces was thirty-eight-and-a-half feet above the rock. Captain Swift says: "Upon these braces the keeper had improperly built a sort of deck or platform, upon which were placed heavy articles such as fuel, water-barrels, etc., which should have been in the store-room designed for their reception. The deck, in addition to the weight placed upon it, was fastened together and secured to the piles and braces, thus offering a large surface, against which the sea could strike. In addition to this, the keeper had attached a five-and-a-half-inch hawser to the lantern deck, and anchored the other end to a granite block, weighing, according to his account, seven tons, placed upon the bottom at a distance of some fifty fathoms from the base of the tower. The object of this was to provide means for running a box or landing-chair up and down; but it is very clear that so much surface exposed to the moving sea had the same effect upon the light-house as would have been produced by a number of men pulling at a rope attached to the highest part of



the structure, with the *design* of pulling it down. . . . At 4 o'clock on Wednesday afternoon, the 16th, or ten hours before the light fell, the platform above mentioned came ashore at Cohasset. As this was forty-three feet above the line of low water, and twenty-eight feet above high water, spring tides, the sea had at that time reached within seven feet of the base of the store-room of the light-house. Without undertaking to speculate upon the probable shock that the structure must have received from the effect of the sea upon a platform fastened to the piles forty feet above the rock, it is enough to know that the sea had reached within seven feet of the body or solid part of the structure. Still increasing, it required but a slight increase in the height of the wave, after having reached the deck, to bring it in contact with the main body of the structure. When this took place it is plain to perceive that such a sea, acting upon the surface of the building at the end of a lever fifty or sixty feet long, must be well nigh irresistible, and I doubt not that the light-house was thus destroyed."

Two light-keepers were at the tower, and were involved in its destruction. So far as I know their bodies were never recovered.

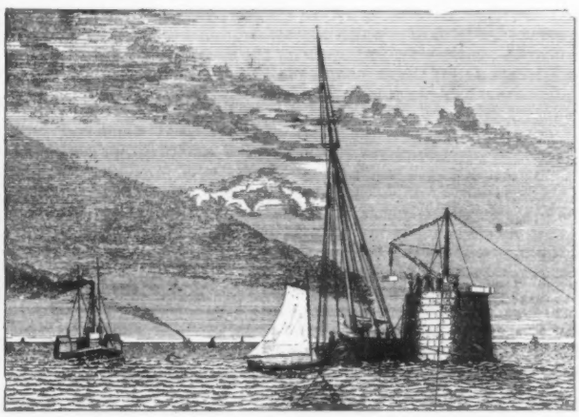
General J. G. Barnard, Corps of Engineers, in his comments on the destruction of this tower says: "In this isolated case of the destruction by wave-violence of a completed structure, there can be little doubt that the engineer's conclusions are correct. The 'main body' (*i. e.* the keeper's dwelling and store-rooms) should never be attainable by waves; all appurtenances, such as scaffoldings (which keepers are so apt to make) and attached hawsers, should be prohibited. A further remark should be made, for in judging of this work it must be borne in mind that it was built at a time when the large grants of money necessary for great engineering works of light-house construction were with difficulty attainable from Congress,[1] at a date, too, when the newly-invented method of skeleton-iron construction for light-houses was still in its infancy.

"The real defect of the Minot iron tower was want of magnitude. It should have had at least a forty-foot base, and a height of one hundred feet. The keeper's dwelling and storerooms could then have been placed beyond the reach of storm waves, the enlarged base affording requisite stability for the increased height. The limited sum at the disposal of the engineer forbade such dimensions. The difficulties of drilling the shaft-holes were, as we have seen, very great, even where the most available parts of the rock were chosen. The enlarged tower, which we *now* know to be necessary, would have cost three times the sum at the command of the engineer."

The importance and necessity to commerce and to life of a light at this point were so apparent that Congress promptly made an appropriation for the purposes of relighting the Minot's Ledge rocks, stipulating, however, that the tower should be erected on the outer Minot and charging the Topographical Bureau with its construction. This Bureau, after advertising for proposals, finally recommended, in view of the great difficulties in the way, and bearing in mind the awful fate of its predecessor, that one of the inner rocks should be selected as the site. While the matter was pending, the present Light-House Board was created (in 1852), and the whole subject was turned over to it.

General G. J. Totten, Chief of Engineers, then a member of the Board, devised the project for the new structure; he advocated and designed a light-house to be erected on the original site. The plans were drawn under his directions and he selected for its execution Captain (afterwards General) Barton S. Alexander, Corps of Engineers, an officer whose experience, skill, boldness and self-reliance eminently fitted him for this arduous task. Alexander thus described the difficulties of the work.

"It was a more difficult work of construction than either the Eddystone, the Bell Rock, or the Skerryvore, for the Eddystone was founded all above low water, part of its foundation being up to high-water level. The foundation of Bell Rock was about three feet above low water, while the Skerryvore had its foun-



dation above high-water level; whereas a good part of the Minot's light was below low water. There had to be a combination of favorable circumstances to enable us to land on the Minot rock at the beginning of that work: *a perfectly smooth sea, a dead calm, and low spring tides.* This could only happen about six times during any one lunation; three at full moon and three at the change. Frequently, one or the other of the necessary conditions would fail; and there were at times months, even in summer, when we could not land there at all. Our working season was from April 1 to September 15. Work was prosecuted with all possible diligence for more than three years before a single stone could be laid. The difficulty was to cut the foundation rock into the proper shape, and then to lay these stones."

Major Ogden, under the orders of the Board, made a careful topographical survey of the rock, with the horizontal curves only three inches apart. The survey showed a plan of the rock at low water, with the curves where horizontal planes, passed three inches from each other vertically both above and below that level, would intersect the rock, these curves being projected on the rock. This survey showed that the highest point of the rock was three feet six inches above low water, and also that it would not be possible to obtain a tower of greater diameter than twenty-two feet without going outside the low-water limit, but by going outside this limit in five places, a diameter of thirty feet could be obtained.

On the first of May, 1855, Captain Alexander first visited Minot's Ledge; he found the stumps of the broken iron piles on the rock, and the wreck of the old light-house was visible under the water. It was difficult to stand on the rock, covered as it was with mussels and sea-weed; but he succeeded in remaining on it for about an hour, and in remeasuring it at dead low water, with the hope that he could get a few inches more than the thirty feet for the foundation; but in this he was disappointed.

[1] The Minot's light-house cost less than $40,000.

Captain Alexander arrived at the following facts and conclusions: Landings, even in summer, could not be made for weeks at a time; parts of the ledge were always under water, and the remainder was only bare for three or four hours; the space was contracted, and during easterly weather the sea broke with such violence that no coffer-dam was possible. The cutting of the rock into shape would evidently be a long, tedious, troublesome and expensive operation, requiring incessant vigilance and the employment of a large party of skilled workmen with all the necessary tools and implements. To have engaged such a party and placed them on board vessels near the rock with instructions to work at every favorable opportunity would have been an easy matter; but the men would have been idle nine-tenths of the time. Their discipline would become lax; when wanted they would not be at their posts, and even if they had they could not have worked like men inured to daily labor. Their hands and muscles would soon have become soft, and they would shortly have been disqualified for the hard labor and exposure in store for them.

A better plan was, therefore, to combine the operation of cutting down the rock with that of preparing the stone for the tower, and to have both done by the same party of workmen, who would thus have constant employment and full wages. To do this an establishment on shore was necessary, with wharf accommodations, store-rooms, work-shops and a stone-yard. In addition there were required the necessary vessels and boats; a gang of stone-cutters could then work on the ledge when sea, weather and tide would permit, and when these would not they would find full employment on shore cutting stone for the tower. A permanent scaffold on the ledge, not a beacon-house, was considered essential. This was to be a structure of iron, to which the workmen could be secured to prevent their being washed from the rock, and would afford temporary security in case of accident to boats or vessels. It would also answer the purpose of a derrick for laying the lower courses of masonry in the tower, and its legs, being enclosed in the masonry, would be so many huge bolts to secure it to the rock. These ideas were embodied in a report to the Board dated May 31, 1855, and were approved.

On the 20th of June a few men were employed to loosen the wedges around the stumps of the old iron piles, and to remove the mussels from the ledge, which was accomplished in a few days.

The first landing for cutting down the rock was made at daylight on Sunday, July 1, 1855. But a small party of men were employed, and the first season's work was confined to marking points of the various levels which were to be cut away, to cutting level spaces around the rock upon which the workmen could stand and upon which tools could be placed in comparative safety, and in general to laying out work for a larger party the next year.

During the year 1855 there were one hundred and thirty hours' work on the rock. During the season of 1856 the iron scaffold previously mentioned was erected. It consisted of nine wrought-iron shafts inserted into the holes of the old iron light-house, and rising to a height of twenty feet above low water, the whole bound together at the top by a strong wrought-iron frame; these shafts were ten inches in diameter at the bottom and seven inches at the top. It gave great confidence to new hands. By stretching lines between the posts across the rock in various directions, and about two or three feet above it, every workman had something within easy reach to lay hold of when a wave broke over the rock.

This year and nearly the whole of the next was consumed in cutting the rock to receive the masonry: the foundation pit was nearly completed, and in 1857 four stones of the foundation were laid. On the nineteenth of January, 1857, the bark "*New Empire*," loaded with cotton, was thrown against the scaffold and swept it from the rock, breaking off the iron posts very much as those of the iron light-house had broken when it was carried away, and shattering the top of the rock in some places so that a portion of the work of the preceding year had to be done over again; in 1856 and '57 the work on the rock was one hundred and fifty-seven and one hundred and thirty hours respectively.

Although a permanent coffer-dam about this rock was impracticable, temporary coffer-dams around small portions of the rock were of great use, both in completing the foundation-pit and in laying the lower stones of the structure. These coffer-dams were made of sand-bags similar to those used in building sand-bag batteries. The bags were about half filled with sand and, being made of heavy cotton duck, were practically water-tight. They were easily handled. Two or three hundred of these bags built up, at low water, around the small portion of the foundation-pit which it was desired to finish, or where a stone was to be laid in mortar, would keep out the water for fully half an hour if the sea was very smooth; the water in the little pits thus made was then bailed out and by means of large sponges was kept nearly dry. These dams required but a few moments in construction, and, as they were easily removed, they were inexpensive. They enabled the engineers to see that the work was properly done, that the foundation was properly completed, that the wooden patterns for the lower stones were correct, and that the lower stones were laid in a bed of mortar properly spread on its foundation.

Nearly all the stones were thus laid. The lowest stone, laid July 11, 1858, and some others, had to be laid in water. The method for securing a bed of mortar under these stones was as follows: A large piece of thin muslin was spread on the platform and a layer of mortar of the required thickness was then spread over it; the stone was then laid on this bed of mortar, the vertical joints of the stone were then plastered with mortar and the cloth was folded up and laid smooth against these vertical joints, cutting away its superfluous parts. After remaining five or ten minutes the mortar would begin to set so that it and the cloth would adhere to the stone. The stone was then laid in its envelope which protected the mortar from the dissolving action of the water, while it was being lowered into position.

Previous experiments on shore on stone cemented together in this way under water, showed that the mortar would ooze through the cloth and make a good bond to the stone below.

All the lower courses of stone were laid from an iron mast which was set up in the central hole of the former light-house. The machinery and rigging which completed the derrick had to be put on and taken off every day that landings were made for laying masonry. It was of simple construction and so arranged as to float in the water, so that all that had to be done in "stripping the derrick" after a tide's work was over, was to cast the machinery loose from the mast and throw it, with the attached rigging, overboard; it could then be towed to the tender.

The mortar used throughout the work was the best quality of pure Portland cement; no lime nor sand was used.

The sketches show how the stone was landed on the rock at different stages of the work.

During 1858 the foundation-pit was finished and the masonry carried up to the sixth course inclusive; this took two hundred and eight working-hours. In 1859 the tower was finished to the top of the thirty-second course, sixty-two feet above low water, in three hundred and seventy-seven working-hours; and in 1860 the tower was completed, the last stone being laid on the twenty-ninth of June, just five years, lacking one day, from the time the workmen landed on the ledge.

No life was lost nor was any one seriously injured during the building of the light-house.

The following were the principal regulations for the safety of the workmen while cutting-down the ledge and laying the masonry of the foundation:

1. No person should be employed on the work who could not swim, or who could not pull an oar and manage a small boat.

2. No landing should be attempted on the rock from one boat; there must always be, at least, two boats.

3. While the workmen were on the ledge, a small boat, with at least three men in it, should be stationed immediately alongside the rock, on its lee side, to pick up the men who were occasionally washed from the rock.

After the destruction of the scaffold which had been erected on the ledge, a new one was prepared similar to the first, but it was never erected as a scaffold. The eight outer posts, however, were inserted in the eight outer holes of the former light-house, after the masonry of the tower had been carried up to the tenth course, the spaces around the posts being filled with a grout of Portland cement. They are supposed to give additional strength to the tower, holding it more securely to its rock foundation.

The light was exhibited for the first time at sunset, November 15, 1860. The cost of the light-house and of the keeper's dwellings on shore, was $300,000.

The structure is solid, around a central well up to the level of the entrance door. Above that there is a hollow cylindrical space, fourteen feet in diameter, arched over at the level of the cornice; this space is divided into five stories by four iron floors; these five compartments and a sixth immediately under the lantern constitute the keeper's rooms, store-rooms, etc.

The shaft is purely conical, the limited bottom area forbidding the expansion required for the tree-like spread to the base, usual in European sea-rock light-houses, which is now believed to be a useless expense and founded on a false analogy.

The following tables may be useful for reference:

Year.	Working-hours.
1855. Excavating foundation-pit,	130
1856. " " "	157
1857. " " " and laying 4 stones,	130.21 m.
1858. " " " and laying 6 courses,	208
1859. Laying 26 courses,	377
Number of tons rough stone,	3514
" hammered stone,	2367
Number of stones in light-house,	1079
Height from bottom of lowest stone to top of pinnacle,	114 ft. 1 in.
Height of focal plane above lowest point,	98 ft 1 in.
" " " " mean high water,	84 ft. 7 in.
Diameter of third, or first full course,	30 ft.
" top of 22d course (solid part),	23 ft. 6 in.

THE ILLUSTRATIONS

[Contributors are requested to send with their drawings full and adequate descriptions of the buildings, including a statement of cost.]

FIRST PARISH CHURCH, MEETING-HOUSE HILL, DORCHESTER, MASS.

[Gelatine Print, issued only with the Gelatine and Imperial Editions.]

THIS building, the successor of several earlier churches, houses the oldest religious society of Boston, as it was organized at Plymouth, Eng., in 1630, before the sailing of the "*Mary and John*." This building was erected in 1816. On the green in front

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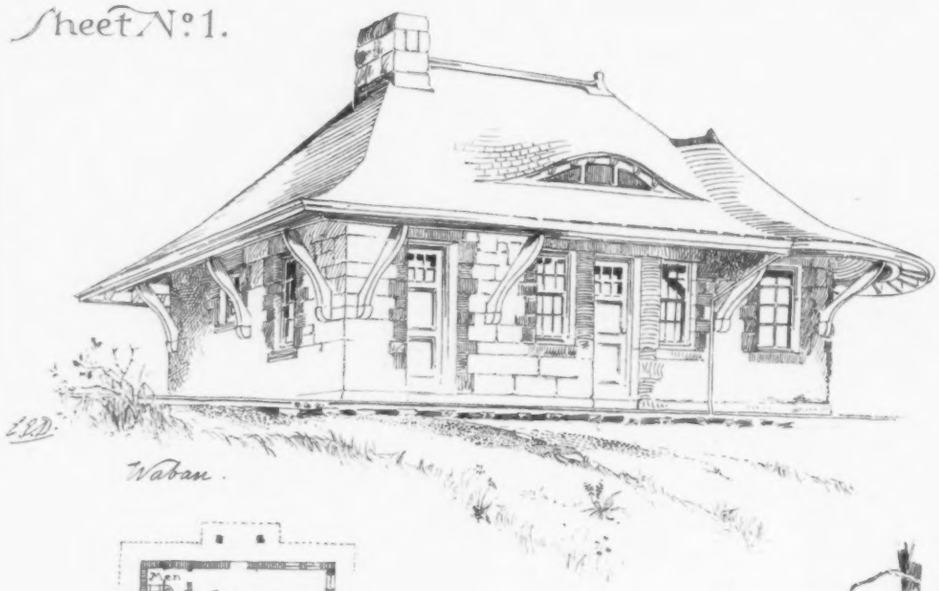
Stations on the Boston & Albany Railroad

Desig

Sheet No. 1.



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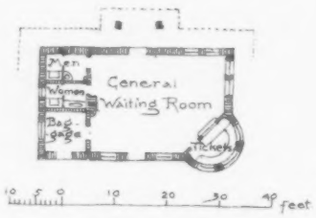
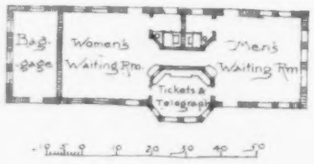


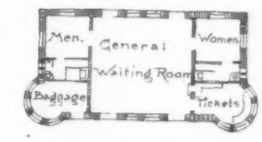


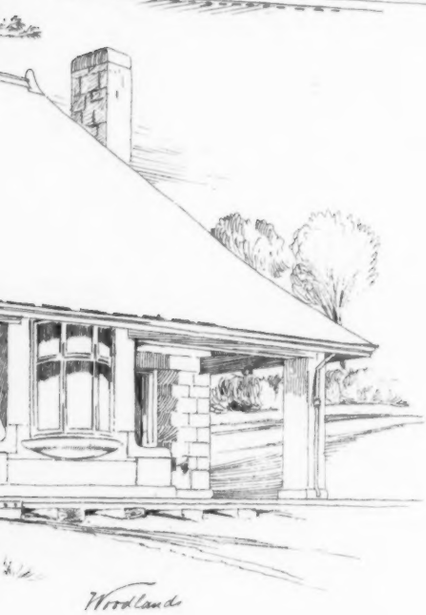
Auburndale.

Designed by the late H.H. Richardson: Archt. Brookline, Mass.

Sketched by E. Eldon Deane.

Wellesley Hills.





Woodland

Brighton

Heliotype Printing Co. Boston.

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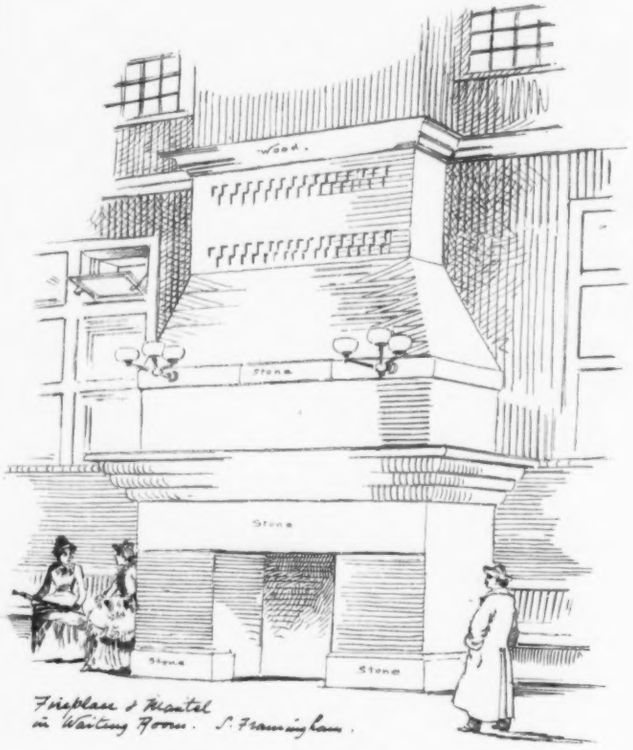
Stations on the Boston & Albany, Old Colony and Connecticut River Railroads.

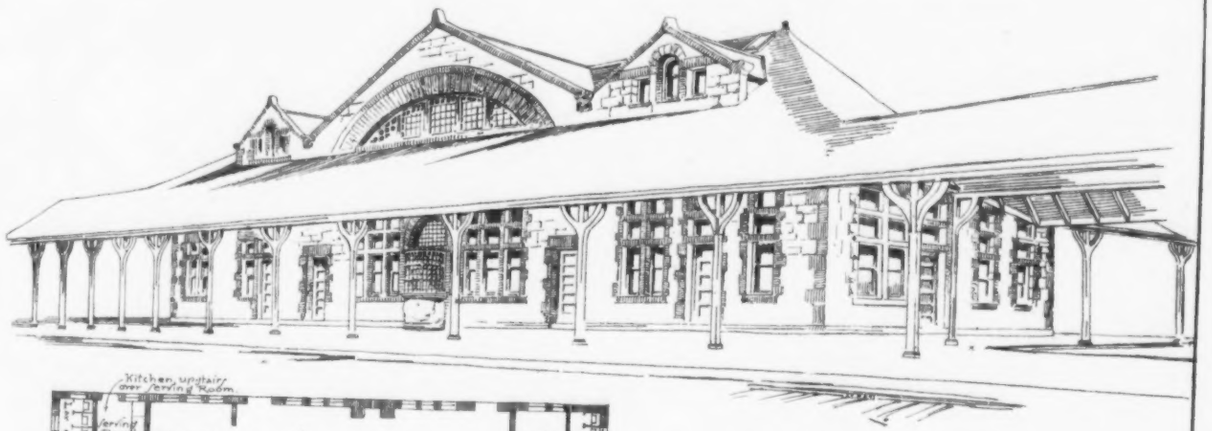
Sheet No. 2.

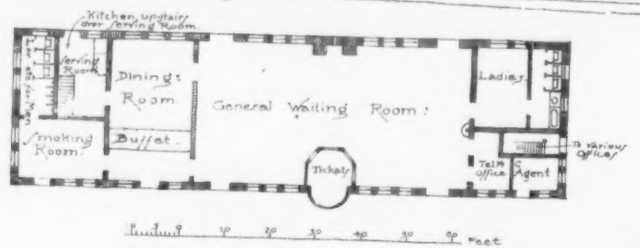
Designed by the late H.H. Richardson. Architect: Brookline: Mass:

Sketched by E. Eldon Deane.

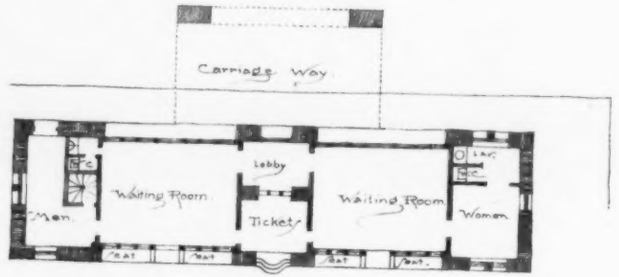


Fireplace & Mantel in Waiting Room. S. Framingham.





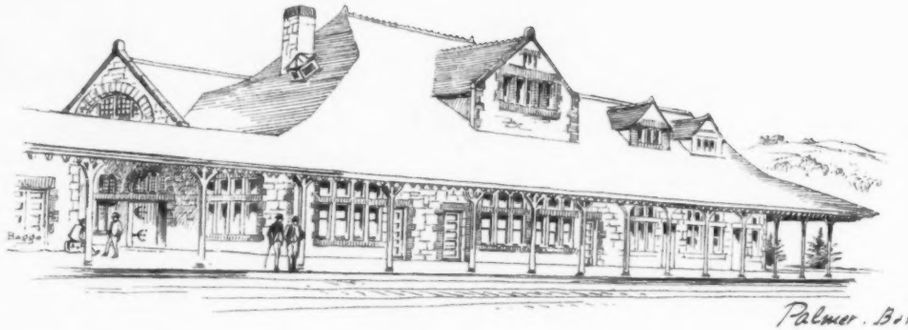
South Framingham. B. & A. R.R.



North Easton. O.C.R.R.

Scale 0 10 20 30 40 50 60 Feet.

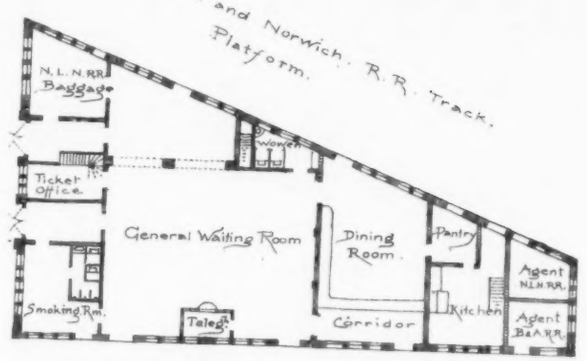
North Easton. O.C.R.R.



Palmer. B & A.R.R.

New London and Norwich. R.R. Track.

Platform.



Platform.

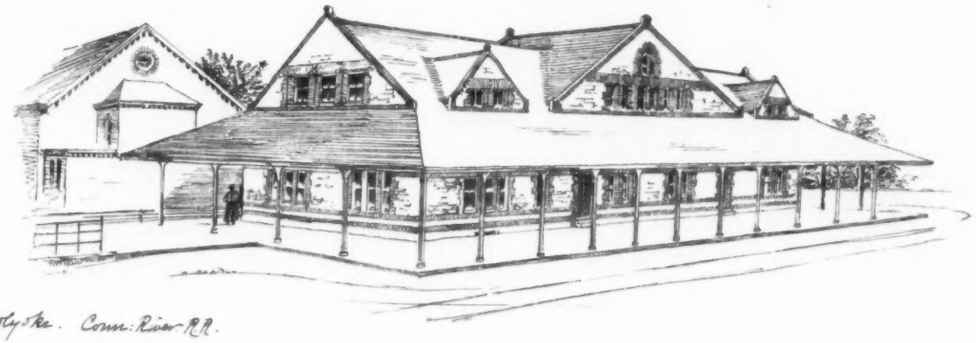
Boston & Albany R.R.s Main Line to Springfield.

Scale 0 10 20 30 40 50 60 70 80 90 100 Feet.

Approximate scale of Feet.

Platform

Scale 0 5 10 15 20 25 30 Feet



Holyoke. Conn: River R.R.

Heliotype Printing Co. Boston

No. 555 American Architect and Building News, Feb. 26 1887.

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HOUSES FOR
I. I. GOLDSMITH ESQ.
T. I. LACEY ARCHT
BINGHAMTON N.Y.
M. P. GAIGE
Builder

MDCCCLXXXVII
C.W. SUMNER DEL
BUFFALO N.Y.

Heliotype Printing Co. Boston.

American Architect and Building News, Feb. 26 1887. No. 553

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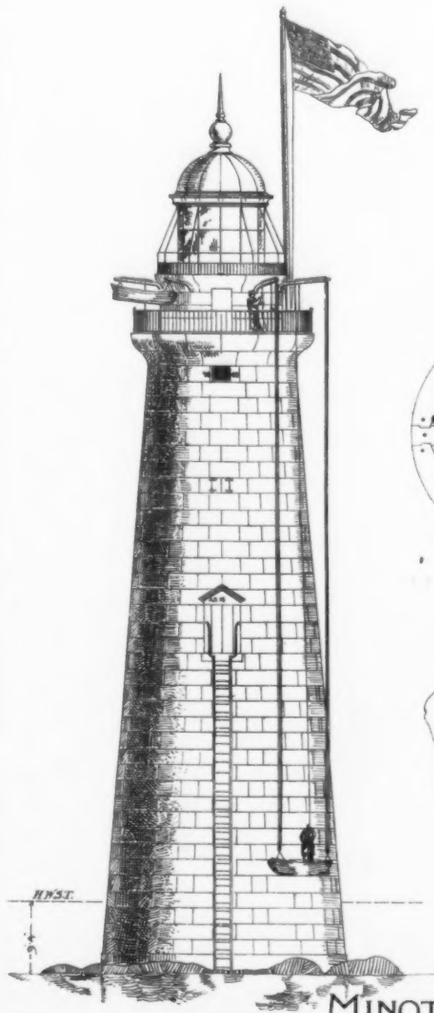
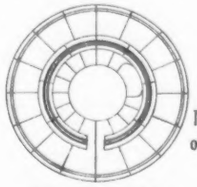
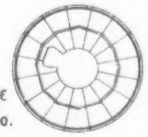


ELEVATION.



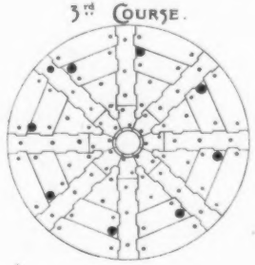
SECTION ON AA.

NEW STONE LIGHTHOUSE ON MINOT'S LEDGE, 1860.

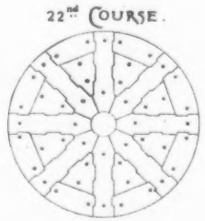


SECTION ON BB.

3rd COURSE.



22nd COURSE.



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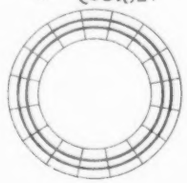
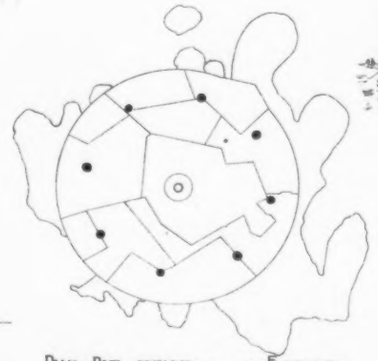
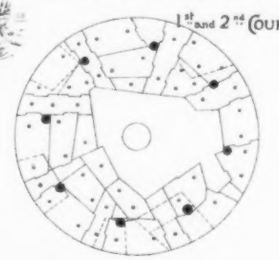


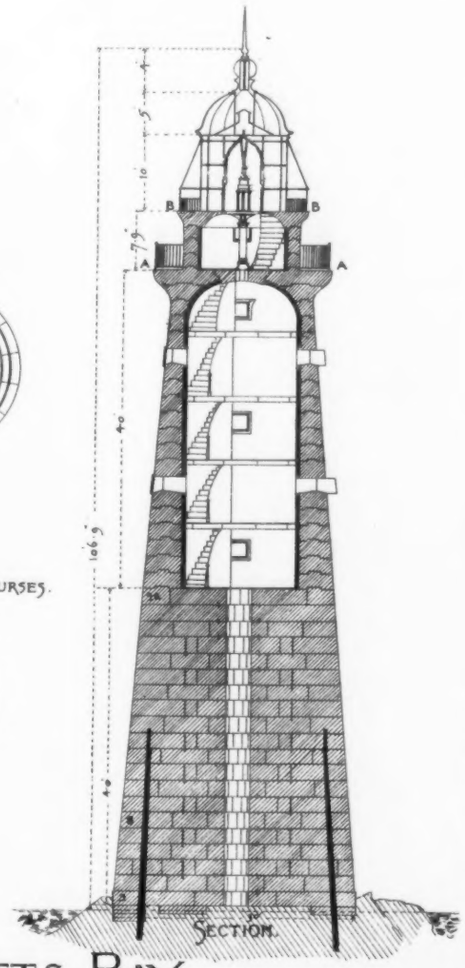
IRON LIGHTHOUSE on MINOT'S LEDGE DESTROYED in a GALE, APRIL 16, 1851.



PLAN OF ROCK AS PREPARED to receive the FOUNDATION.

1st and 2nd COURSES.





SECTION.

MINOT'S LEDGE LIGHTHOUSE near Cohasset, MASSACHUSETTS BAY.

Sutcliffe, Del.

Heliotype Printing Co Boston.

stands the monument to the memory of the soldiers of Dorchester who fell in the civil war.

RAILWAY STATIONS AT WELLESLEY HILLS, WABAN, WOODLAND, AUBURNDALE, BRIGHTON, SOUTH FRAMINGHAM, PALMER, HOLYOKE, AND NORTH EASTON, MASS., DESIGNED BY THE LATE H. H. RICHARDSON, ARCHITECT.

MINOT'S LEDGE LIGHT-HOUSE, BOSTON HARBOR, MASS.

FOR description see article on "Ancient and Modern Light-Houses," elsewhere in this issue.

HOUSE OF I. I. GOLDSMITH, ESQ. MR. T. I. LACEY, ARCHITECT, BINGHAMTON, N. Y.

HABITATIONS AFFECTED BY ENVIRONMENT.

A Navajo Hut.

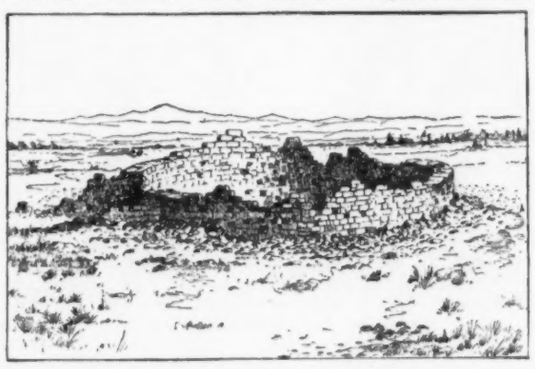
BY the courtesy of Major Powell, Director of the Ethnological Bureau, we are enabled to publish from the advance sheets of his forthcoming report, the following portion of Mr. F. H. Cushing's interesting "Study of Pueblo Pottery as Illustrative of Zuñi Culture-growth:"

It is conceded that the peculiarities of a culture-status are due chiefly to the necessities encountered during its development. In this sense the Pueblo phase of life was, like the Egyptian, the product of a desert environment. Given that a tribe or stock of people is weak, they will be encroached upon by neighboring stronger tribes, and driven to new surroundings if not subdued. Such we may believe was the influence which led the ancestors of the Pueblo tribes to adopt an almost waterless area for their habitat.

It is apparent at least that they entered the country wherein their remains occur, while comparatively a rude people, and worked out there almost wholly their incipient civilization. Of this there is important linguistic evidence.

A Navajo hogan, or hut, is a bee-hive shaped or conical structure of sticks and turf or earth, sometimes even of stones chinked with mud. Yet its modern Zuñi name is *hám' pon ne*, from *ha we*, dried brush, sprigs or leaves; and *pó an ne*, covering, shelter or roof (*po a* to place over and *ne* the nominal suffix); which, interpreted, signifies a "brush or leaf shelter." This leads to the inference that the temporary shelter with which the Zuñis were acquainted when they formulated the name here given, presumably in their earliest condition, was in *shape* like the Navajo hogan, but in *material* of brush or like perishable substance.

The archaic name for a building or walled inclosure is *hé sho ta*, a contraction of the now obsolete term, *hé sho ta pon ne*, from *hé sho*,



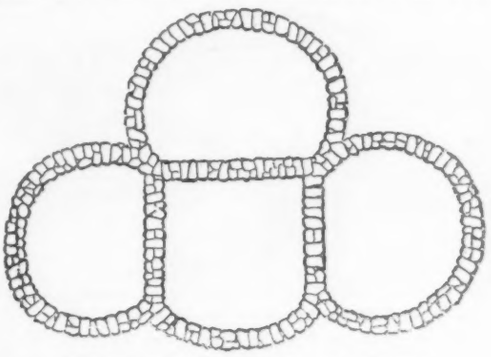
View of earliest, or Round-house Structure of Lava.

gum, or resin-like; *shó tai e*, leaned or placed together convergingly; and *tá po an ne*, a roof of wood or a roof supported by wood.

The meaning of all this would be obscure did not the oldest remains of the Pueblos occur in the almost inaccessible lava-wastes bordering the southwestern deserts and intersecting them, and were not the houses of these ruins built on the plan of shelters, round rather than rectangular. Furthermore, not only does the lava-rock of which their walls have been rudely constructed resemble natural asphaltum (*hé sho*), and possess a cleavage exactly like that of piñon-gum and allied substances (also *hé sho*), but some forms of lava are actually known as *á he sho* or gum-rock. From these considerations inferring that the name *hé sho ta pon ne* derivatively signifies something like "a gum-rock shelter with roof supports of wood," we may also infer that the Pueblos, on their coming into the desert regions, dispossessed earlier inhabitants, or that they chose the lava-wastes the better to secure themselves from invasion; moreover that the oldest form of building known to them was therefore an inclosure of lava-stones, whence the application of the contraction *hé sho ta* and its restriction to mean a walled enclosure.

RECTANGULAR FORMS DEVELOPED FROM CIRCULAR.

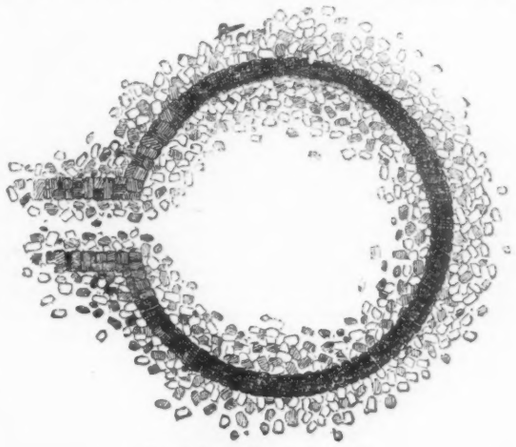
It may be well in this connection to cite a theory entertained by Mr. Victor Mindeleff, of the Bureau of Ethnology, whose wide experience among the southwestern ruins entitles his judgment to high



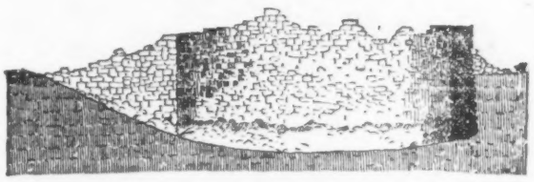
Evolution of rectangular forms in Primitive Architecture.

consideration. In his opinion the rectangular form of architecture, which succeeds the type under discussion, must have been evolved from the circular form by the bringing together, within a limited area, of many houses. This would result in causing the wall of one circular structure to encroach upon that of another, suggesting the partition instead of the double wall. This partition would naturally be built straight as a twofold measure of economy. Supposing three such houses to be contiguous to a central one, each separated from the latter by a straight wall, it may be seen that the three sides of a square are already formed, suggesting the parallelogramic as a convenient style of sequent architecture.

All this, I need scarcely add, agrees not only with my own observations in the field but with the kind of linguistic research above recorded. It would also apparently explain the occurrence of the



Plan of Pueblo Structure of Lava.



Section of Pueblo Structure of Lava.

circular semi-subterranean *ki wi tsi we*, or estufas. These being sacred, have retained the pristine form long after the adoption of a modified type of structure for ordinary or secular purposes, according to the well-known law of survival in ceremonial appurtenances.

In a majority of the lava ruins (for example those occurring near Prescott, Arizona), I have observed that the sloping sides rather than the level tops of *mesa* headlands have been chosen by the ancients as building-sites. Here, the rude square type of building prevails, not, however, to the entire exclusion of the circular type, which is represented by loosely-constructed walls, always on the *outskirts* of the main ruins. The rectangular rooms are, as a rule, built row above row. Some of the houses in the upper rows give evidence of having overlapped others below.

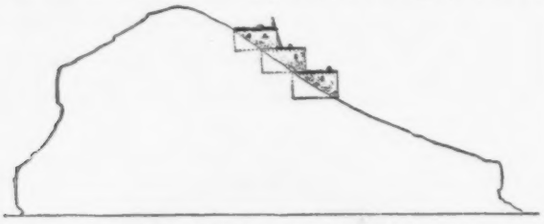
FLAT AND TERRACED ROOFS DEVELOPED FROM SLOPING MESA SITES.

We cannot fail to take notice of the indications which this brings before us.

Typical Terraced Communal Pueblo.

(1) It is quite probable that the overlapping resulted from an increase in the numbers of the ancient builders relative to available area, this, as in the first instance, leading to a further massing together of the houses. (2) It suggested the employment of rafters and the formation of a *flat* roof as a means of supplying a level entrance-way and floor to rooms which, built above and to the rear of a first line of houses, yet extended partially over the latter. (3) This is, I think, the earliest form of the terrace.

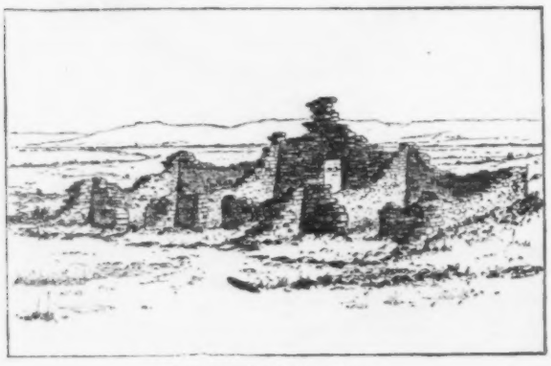
It is, therefore, not surprising that the flat roof of to-day is named *té k'os kwĭn ne*, from *te*, space, region, extension, *k'os kwi e*, to cut off, in the sense of closing or shutting in from one side, and *kwin ne*,



Section illustrating Evolution of Flat Roof and Terrace.

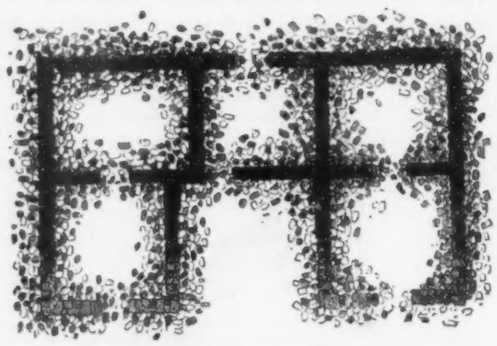
place of. Nor is it remarkable that no type of ruin in the Southwest *seems* to connect these first terraced towns with the later not only terraced but also literally cellular buildings, which must be regarded nevertheless as developed from them. The reason for this will become evident on further examination.

The modern name for house is *k'iá kwĭn ne*, from *k'iá we*, water, and *kwin ne*, place of, literally "watering-place"; which is evidence that the first properly so-called houses known to the Pueblos were



View of Typical Solitary House.

solitary and built near springs, pools, streams, or well-places. The universal occurrence of the vestiges of single houses throughout the less-forbidding tracts of the Pueblo country leads to this inference and to the supposition that the necessity for protection being at last overcome, the denizens of the lava-fields, where planting was well-nigh impossible, descended, building wherever conditions favored the horticulture which gradually came to be their chief means of support. As irrigation was not known until long afterwards, arable areas were limited; hence they were compelled to divide into families or small clans, each occupying a single house. The traces of these solitary farm-houses show that they were at first single storied. The name of an upper room indicates how the idea of a second or third story was

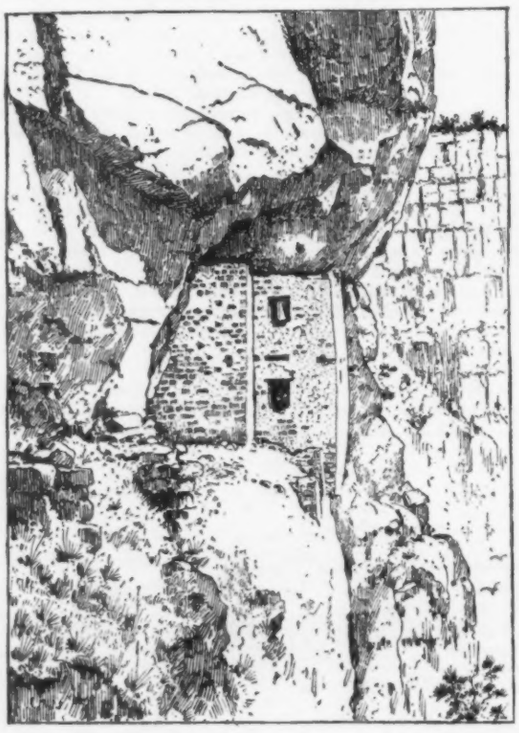


Plan of Typical Solitary House.

developed, as it is *ósh ten u thlan*, from *ósh ten*, a shallow cave, or rock-shelter, and *ú thla nai e*, placed around, embracing, inclusive of. This goes to show that it was not until after the building of the first small farm-houses (which gave the name to houses) that the caves or rock-shelters of the cliffs were occupied. If predatory border-tribes, tempted by the food-stores of the horticultural farm-house builders, made incursions on the latter, they would find them, scattered as they were, an easy prey.

ADDED STORIES OF CLIFF-DWELLINGS DEVELOPED FROM LIMITATIONS OF CLIFF-HOUSE SITES.

This condition of things would drive the people to seek security in the neighboring cliffs of fertile cañons, where not only might they build their dwelling-places in the numerous rock-shelters, but they could also cultivate their crops in comparative safety along the limited tracts which these eyries overlooked. The narrow foothold



A Typical Cliff-Dwelling.

afforded by many of these elevated cliff-shelves or shelters would force the fugitives to construct house over house; that is, build a second or upper story around the roof of the cavern. What more natural than that this upper room should take a name most descriptive of its situation — as that portion built around the cavern-shelter or *ósh ten* — or that, when the intervention of peace made return to the abandoned farms of the plains or a change of condition possible, the idea of the second story should be carried along and the

name first applied to it survive, even to the present day? That the upper story took its name from the rock-shelter may be further illustrated. The word *ósh ten* comes from *ó sho nan te*, the condition of being dusky, dank, or mildewy; clearly descriptive of a cavern, but not of the most open, best lighted, and driest room in a Pueblo house.

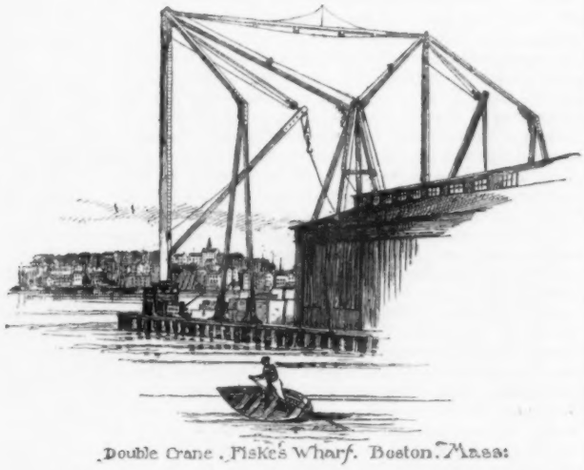
To continue, we may see how the necessity for protection would drive the petty clans more and more to the cliffs; how the latter, at every available point, would ultimately come to be occupied, and thus how the "*cliff-dwelling*" was confined to no one section, but was as universal as the farm-house type of architecture itself, so widespread, in fact, that it has been heretofore regarded as the monument of a great, now extinct, *race* of people!

COMMUNAL PUEBLOS DEVELOPED FROM CONGREGATION OF CLIFF-HOUSE TRIBES.

We may see, finally, how at last the cañons proved too limited and in other ways undesirable for occupation, the result of which was the confederation of the scattered cliff-dwelling clans, and the construction, first on the overhanging cliff-tops, then on *mesas*, and farther and farther away, of great, many-storied towns, any one of which was named in consequence of the bringing together in it of many houses and clans, *thlu él lon ne*, from *thlu a*, many springing up, and *él lon a*, that which stands, or those which stand; in other words "many built standing together." This cannot be regarded as referring to the simple fact that a village is necessarily composed of many houses standing together. The name for any other village than a communal pueblo is *ti na kwïn ne*, from *ti na* — many sitting around, and *kwïn ne*, place of. This term is applied by the Zuñis to all villages save their own and those of ourselves, which latter they regard as Pueblos, in their acceptation of the above native word.

Here, then, in strict accordance with the teachings of myth, folk-lore and tradition, I have used the linguistic argument as briefest and most convincing in indicating the probable sequence of architectural types in the evolution of the Pueblo; from the brush-lodge, of which only the name survives, to the recent and present terraced, many-storied, communal structures, which we may find throughout New Mexico, Arizona, and contiguous parts of the neighboring territories.[1]

TWO MONSTER CRANES.



Double Crane, Fiske's Wharf, Boston, Mass.

SIXTEEN powerful horses, four abreast, attached to a low four-wheeled caravan, upon which was a twenty-eight-ton block of Italian marble, were noticed, the other day, says a writer in the *Boston Herald*, issuing from the gateway of Fiske's wharf, Commercial Street, where, by the way, every ton of foreign marble coming to the port of Boston is handled. The writer sought Mr. Nichols, the wharfinger, and was invited to witness the unloading of the bark "*Anita Menotti*," from Leghorn, then discharging a cargo of nine hundred tons of sculptors' marble. Employed in this work were two monster cranes, which were seen in operation. These cranes are said to be unlike any others in the country, in that they can handle almost unlimited weights with the greatest ease. Incidentally, it may be said, that this machinery put into position the masts of the "*Puritan*," "*Gitana*," "*Fortuna*," "*Mayflower*," and other crack yachts, and hardly a day passes but they are used to lift out the spars of vessels of our merchant fleet, doing it in a twinkling, without even the necessity of unshipping topmasts. Only a few days ago a capsized mud-scow was towed alongside the wharf; three strong chains were quickly passed under the scow and fastened to the under near edge; the machinery was put in motion, and in a trice the scow was floating on its bottom, righted. A large-sized yacht was recently brought to the wharf on the deck of a Leyland line steamer; strong cable straps were attached, and quicker than it takes to tell it, the yacht was in the air, and by rotating the crane was landed in the water hard by.

An immense planer, weighing forty tons, which had taken ten hours to stow in the hold of a vessel, was brought under the crane to be lifted out; the hydraulic jacks lifted the planer so that straps could be fastened around it, and the wharf-machinery quickly snaked it immediately under the main hatch; the ropes, or slings, and three-foot "S" hook and blocks, suspended from the boom of the crane, were swung over and made fast; the engine puffed, the gearing strained and cracked, the great machine was slowly elevated twenty feet above the vessel's deck, the crane revolved on its axis, and the machine was landed safely upon the huge caravan standing near at hand to receive it. It required twenty horses to drag the van through the city to South Boston, its intended destination. Permission to go over Federal-street bridge could not be obtained unless the shippers would lay a new and special flooring on the bridge proper. This was done, and as the wheels of the van passed over the flooring the crushed wood curled up after each wheel, as snow does behind the cart-wheel in winter. The machine was soon safely landed and placed in position.

From the above illustrations the immense power of the cranes can be readily conceived. Mr. Nichols, the wharfinger, conducted the writer to the end of the wharf, introducing him to Tim Tutein the crack stevedore, who, with his men, eight in number, was unloading the marble cargo of the "*Menotti*." Great blocks of marble, weighing from ten to thirty tons, were issuing from the hold of the bark in quick succession, and by the swinging cranes they were safely deposited in positions on the wharf, as though they did not weigh as many pounds as was their weight in tons. The ship was nearly empty, only forty hours having been employed to discharge the nine-hundred-ton cargo, and all of this time was not all employed on the work, one crane being most of the time used on mast work.

To give a minute description of the cranes would occupy too much space, but an idea may be obtained from the following figures and explanation: A few feet from the end of the wharf stands a mast ninety feet high and thirty inches in diameter at the base. Springing out, some ten feet above the step of the mast, is a boom sixty feet long and twenty inches in diameter. The step is of heavy iron castings, arranged so that a rotary motion of the whole rigging can be had at will; from the engine-house, twenty-five feet in the rear, comes a seven-inch manila rope, passing over a monster drum, thence under the flooring of the wharf, around a lateral sheave, thence to the centre of the mast, piercing its core and coming out at the boom; then it runs over another sheave to the tip end of the boom, where it runs over another twenty-inch sheave, one of three set in the centre of the boom. From there it passes into two five-sheave pulley-blocks, forming with the sheaves in the boom a five-part tackle. The pulley-blocks are huge affairs, being about three feet long by two feet wide, made entirely of steel and wrought-iron. Another seven-inch rope is used as a boom fall, this rope passing from the engine-house through the roof and over the large stationary wooden guys which hold it in position. There are eighty-five fathoms of rope in the mast fall and seventy fathoms in the boom fall. The stationary iron collar in which the head of the mast revolves, and to which the ends of the guys are fastened, weighs seven hundred pounds; the head of the mast revolves in this collar upon round steel balls, which give it a ball-bearing action. The rotating gearing at the base of the mast allows the crane to swing around as desired and deposit its load wherever wished, within a radius of sixty feet. The guys which stay the mast in position are wooden, and lead down to the top of an "A" base of 12″ x 12″ hard-pine timbers, fastened with hackmatack knees and wrought-iron straps at every angle. The timbers of the braces are of the same size as those of the guys, and fastened to the wharf in the same manner. The guys referred to meet those of the "sister crane," a duplicate of the one described, about forty feet distant, and together make the support for each perfect. The lifting-capacity of these cranes is almost unlimited, and it is conceded that they are the most powerful stationary lifting and rotating derricks in the country, taking into consideration the immense sweep they have and the height to which freight can be raised. Since their erection by Mr. Nichols, who designed them, not an accident has happened, for Mr. Tutein, who gives his "pets," as he calls them, his personal attention, will not allow a rope or fall to be used after it has been strained to the extent imposed upon it in the lifting of a certain number of tons weight. Although the rope may look strong and without signs of wear, it is taken off, cut up in cable straps and bands, and a brand-new seven-inch manila rope substituted; this, doubtless, is a very wise precaution, as the dearth of accidents attests. "As an example of the strength of the crane," said Mr. Nichols, "one was at work not long ago lifting from the hold of a vessel an immense weight, the bulk of which was so great as to entirely fill the hatchway, and becoming jammed, through the carelessness of one of the stevedore's men, the machinery was actually pulling against the vessel and cargo, consequently the weakest part gave way, and that was the "S" hook, a gigantic affair, made of the finest three and one-half-inch Swedish iron, parting it in the middle as though it had been a piece of putty. Since then "S" hooks, before being used, are tested to sustain a weight equal to one hundred tons." Mr. Nichols further said that had he been wiser he would have patented his cranes, for mechanical engineers have credited him with

[1] See for confirmation the last Annual Report to the Archæological Institute of America, by Adolph F. Bandelier, one of the most indefatigable explorers and careful students of early Spanish history in America.

designing the best crane extant, as the number now being erected from his plans in various parts of the country attest.

DISINFECTION AT BERLIN.

IN the Paris *Journal d'Hygiène* for the 6th of January, the editor, Dr. de Pietra Santa, devotes several pages to a highly-interesting and instructive review of the progress of municipal cleanliness in the city of Berlin, since the alarm created by the great small-pox epidemic of 1871–2. The material is obtained from a professional report by MM. Alfred Durand-Claye and Albert Petsche, in which modern European experience on a large scale is adduced to show that the problem of the purification of towns, and the suppression of the epidemic form of the zymotic diseases can be solved by the adoption of the three following measures:

1. Removal of liquid refuse and excreta by sewerage.

2. Sufficiency of water-supply for household purposes and flushing of sewers.

3. Deodorization of the sewage by utilizing it on sewage-farms. The application of these wise and practical principles to Berlin, says Dr. de Pietra Santa, is producing the anticipated results. The condition of this city, which fifteen years ago was detestable, is now much improved by the progress already made in carrying out the above-named measures. The city is not favorably situated for drainage, lying in a flat and sandy plain, and being intersected by the various arms of the sluggish Spree. The water-level, too, is in some parts but a few feet below the surface. Those who may have visited the capital in 1873 or earlier, will remember the deplorable state of its ill-paved streets, the deep and odorous gutters, receptacles of rainfall, of house sewage, and often of excreta, bridged over by planks giving access to the dwellings; the discolored and fœtid river, gliding slowly through the city, being the common reservoir. The dwellings were provided with cesspits, or more commonly with deep cavities, by means of which fæcal matters were enabled to percolate into the subsoil; and much of the water-supply was obtained from private or public wells excavated in this dangerously-polluted material. Under these unfavorable conditions, it is not surprising that the mortality of the city reached in 1871 the high figure of thirty-nine in the thousand of population. The extent of zymotic mortality at length aroused the authorities, and the Berlin municipality determined on making a supreme effort to free the city from conditions so prejudicial to public health, and so mortifying to the national pride.

The new water-works were undertaken by an English company; the general plan for the purification of the city, and the closing of the reign of epidemics, was approved in 1873, and operations were commenced in 1874. In ten years the greater part of the colossal work was completed, and at the present time nearly all Berlin is living (says Dr. de Pietra Santa) under arrangements which many a European capital might envy. Streets have been relaid and repaved after the most approved pattern; an increase in the water-supply has been obtained by attaching filter-beds to the lakes in the vicinity, and the radial system of sewers is an excellent method of conveying to the separate sewage-farms the various impurities of the city. The thin stratum of sandy soil in the environs reposes on a difficult subsoil, necessitating lessened doses of sewage and farms of greater extent; yet no complaint is raised in the neighborhood, although it comprises many suburban dwellings. The success of the new sewerage is incontestable. The prophets of failure are silent, and there is a general desire to connect the dwelling with the sewer. Although the work is still incomplete, there has been a satisfactory reduction in mortality, especially in that from typhoid fever. The great problem of the purification of a large capital has thus been solved in a remarkable manner. In 1873 everything had to be done, and in the forthcoming year it is expected that the work will be completed.

These interesting details of sanitary effort in Berlin, supported by the experience of our own metropolis, furnish a further and striking confirmation of the power of municipal cleanliness, when thoroughly brought into action, in the speedy removal of liquid and solid refuse, to seriously mitigate, if not absolutely to avert, the epidemic form of any and every zymotic disease.

The Berlin authorities are proud of the reduction effected in typhoid fever; they have equal cause for pride in the reduction, by the same means, of the mortality from small-pox, which in the face of unbounded pressure of vaccination and revaccination for a series of years, destroyed 6,478 citizens in the epidemic of 1870–72, but has since been compelled to content itself, from 1875 onwards, with a mortality too insignificant to particularize. — *H. D. Dudgeon in the Sanitary World.*

THE "*TRANSACTIONS*" OF THE ROYAL INSTITUTE OF BRITISH ARCHITECTS.

IT may not be generally known that, during the past year, the volume of "*Transactions*" of the Royal Institute has served to increase the customs revenue of the United States. In one prosperous city a collector of customs has had the volume before him, has examined it, has discovered that it consists of two or three numbers of a serial bound in one, that its cover, though a paper one, is of two or three papers stuck together — a stiff cover being, to transatlantic customs officials, an irritant inducive of taxation — that, in fine, it is a periodical which makes money, and out of which money ought to be made. The result is that four Honorable Corresponding Members, eight institutions, and two newspapers, located in the United States, have each, presumedly, had to pay duty for the volume (II, new series), presented to them, post-paid, in November last. Had, however, the "*Transactions*" been sent in three parts separately, as each part appeared, it is stated that they would have been admitted free; and consequently future issues intended for the United States will be sent in that manner. The United States are apparently alone, among the nations of the world, in levying toll on a private gift made by the architects of this country to honored *confrères* (not their own countrymen), and to kindred institutions abroad.

The facts, nevertheless, are these: Every year, of late years, the Royal Institute makes up 1,500 volumes of its "*Transactions*," independently of "short" copies of papers, of a few separate parts, and of this *Journal of Proceedings*. The volumes, published in October, are issued during the month to members, and every member, subscribing or non-subscribing, receives a copy. About thirty members prefer to receive the "*Transactions*" in three parts instead of in a complete volume, and consequently a certain number of copies, sewn in a thin cover, are issued to those gentlemen in January, April and August, and it is always possible for members, both at home and abroad, to obtain the work in this divided form. Those who reside abroad are alone asked, as a matter of precaution, to return a printed letter of acknowledgement which is sent in the packet containing the volume, and the majority, perhaps, have complied with this request. Where, in particular cases, no notice has been taken for any length of time of the receipt of the volume, the further issue of the R.I.B.A. publications is suspended, at least until some intimation arrives of the actual existence or whereabouts of the member in question. The same course is pursued with institutions, and until a receipt is received from their secretaries, or their librarians, for which a due allowance of time is always given, the further issue ceases. This course is necessitated by many reasons, not the least being the increased size and cost of the volumes of "*Transactions*," the increased demand for them by societies and educational bodies, and the comparatively large outlay for foreign and colonial postage. At present ninety-four institutions, exclusive of newspapers, periodically receive the publications of the Royal Institute, and this over and above those sent to members. Of the ninety-four copies, sixty-seven are distributed throughout Great Britain and Ireland, and twenty-seven abroad. Besides which, the Governments of India, of Madras, and of Bombay, receive nine copies (three to each); moreover, among the foreign Honorary Corresponding Members, Austria and Germany receive eleven copies, Denmark two, France, Holland and Belgium twenty-six, Greece one, Italy six, Russia two, Spain and Portugal three, and the United States four copies. No encouragement is given to the public sale of these volumes, for no reduction is allowed on them to the trade. A member may purchase extra copies, and if he do so he is allowed a discount of twenty-five per cent, but outsiders and the trade have to pay the full price. Indeed, far from any attempt to make a profit out of such publications, the Royal Institute has studiously done its best to render such a result impossible; and strange as it may sound to commercial ears, in these go-a-head days, more heed has been always given to applications from the chiefs of libraries and schools, and from architectural societies, asking to be presented with these works, than to outsiders who have offered to pay for them.

SOCIETIES

A CINCINNATI SKETCH-CLUB.

CINCINNATI, February 19, 1887.

THE architectural draughtsmen and students in the various offices have just organized themselves as a sketch-club, and from all appearances the organization promises to be of considerable benefit to the architects as well as to the students, from the fact that the architects will indirectly reap the fruits of the knowledge and zeal that is sure to result to the young men in their studies.

The architects have given the movement their approval and each one in his turn is to be called upon to act as critic in the friendly competitions to be instituted among the juniors.

CHARLES CRAPSEY.

A CORRECTION.

CLEVELAND, OHIO.

TO THE EDITORS OF THE AMERICAN ARCHITECT:—

Dear Sirs,— The president of the Ohio State Association of Architects, Mr. C. F. Schweinforth, is of Cleveland, and not of Dayton, as stated in your issue of February 12, page 73.

Very truly, F. A. COBURN, *Secretary.*

BOOKS AND PAPERS.

JUST too late to be of avail as a somewhat expensive souvenir of the two hundred and fiftieth anniversary celebration of Harvard College, was published the fourth of the series of "*Monographs of American Architecture*,[1]" devoted to the treatment of Memorial Hall — Alumni Hall, we believe, is its proper and somewhat hybrid name — a building which, besides its reflected glory as the central feature of the present University buildings, will always have considerable interest for architects. For those who know the history of the building and the manner in which a comparatively modest design was expanded and developed, as more and more money was dropped — not poured — into the coffers of the building-committee, it is easy to see in the completed work where the architects found themselves in a po ition to re-study and enlarge on their original design. For our own part we have always regretted that the original design was not more closely adhered to; it was more scholastic and in keeping with the modest merits of the other college buildings, though perhaps as a memorial of high achievements in paths widely divergent from the peaceful walks of scholars, the more aspiring structure is the more fit. Certainly from many points of view the building is a success, and if one could forget the "asses' ears," which, as roofs to the pavilions at the base of the great tower, contend so masterfully for the observer's attention, the building externally would meet with little but approval. But it is within that the architects have succeeded best. The vestibule — the memorial hall proper — is an imposing apartment, and one can easily forgive the wooden groining of the ceiling and overlook the not too successful attempt at polychromy in the heads of the marble memorial tablets, which recalls the still more distressing polychromatic vagaries practised in the slating of the roofs. The dining-hall is probably one of the most successful rooms in the country, not only from the architectural but from the practical standpoint, and its acoustic properties are unusually good. Here, too, can be seen some of the best of the work of modern glass-stainers, shown in memorial windows presented by different classes. Although several of these windows have been put in place within the last year or two, still the great west window, which was set when the building was still in the hands of the architects, holds its own marvellously as a very satisfactory piece of color-work,— extraordinarily so, considering the state of the glass-stainer's art at that time in this country. But perhaps the part of the structure which is the most successful, as it was the most likely to result in a failure, is the Sanders Theatre, where all the public literary exercises take place. In arrangement this part of the building is as convenient and commodious as space would allow; in color it is quiet and soothing, and its acoustic properties, the all-important desideratum, are said to be all that could be desired. We believe that it is considered the best hall for the rendition of music in the neighborhood of Boston, the city itself included.

The gelatine prints which exhibit the merits of the building are in keeping, as to quality, with those issued in former numbers of the series, and they give an excellent idea of a very large and important structure.

[1] "*Monographs of American Architecture*, IV. — *The Memorial Hall, Harvard College*," Cambridge, Mass. Messrs. Ware & Van Brunt, Architects. Boston: Ticknor & Co., 1886. Price $5.00.

COMMUNICATIONS.

ADVICE TO ARCHITECT SUITORS.

MACON, GA., February 15, 1887.

TO THE EDITORS OF THE AMERICAN ARCHITECT:—

Dear Sirs,— The Albany architect who writes you about a suit he has commenced against a client, if he were to consult a large number of his professional brethren, would probably receive from most of the older ones some such *report* as I propose to make to him.

I was "articled" in an architect's office on the 1st November, 1850, and since that time have learned several things, one of them being that an architect can scarcely make a poorer use of his time than to use it in a law suit. It is true I have never taken a client into court, and never intend to, but I have often seen it done.

I conclude that it does n't pay. If your client does n't want to settle on your terms, offer to settle on his terms. If he refuses to settle at all, tell him to go to —— well, Jericho, that being a road supposed to be travelled by thieves.

Peace of mind is too valuable and too scarce in an architect's office, to be sacrificed for the largest fee an architect was ever defrauded of; though my experience would lead me to believe that an architect's clients are, for the most part, good people, who mean to pay and are willing to pay. Keep clear of the other kind, but never undertake to fight them. B.

WEIGHT OF FLOUR IN TIERS.

PROVIDENCE, January 21, 1887.

TO THE EDITORS OF THE AMERICAN ARCHITECT:—

Dear Sirs, — In response to Mr. Kidder's inquiries, as to weight of material, I would say that flour in barrels, on their side, weigh forty-four pounds per square foot for each tier. Yours truly, A. S.

NOTES AND CLIPPINGS.

STEADYING CHIMNEYS BY LOADING.— Mr. A. Hollenberg contributes to the *Zeitschrift* of the German Society of Engineers, an article upon the prevention or diminution of oscillation in chimney-stacks and high walls, by loading with an excess of dead weight. He cites an instance of a chimney only fifty-six feet high, built in common lime mortar, which, when completed, was observed to oscillate to an alarming degree. Consequently the chimney was loaded by putting on the top an iron plate weighing upward of two-and-one-half cwt. The cure was perfect. Although the stack is built in an exposed situation, it has stood for sixteen years, during which many severe storms have tried its strength, yet it does not show any horizontal or vertical cracks. Similar results are recorded in connection with the construction of a mill at Müllfort, near Rheydt. Here a mill-owner found it necessary to heighten a building by two stories, without interrupting work in the factory below. The constant vibration caused by the machinery, however, destroyed the walls as soon as the bricks were laid. To check this effect the walls were heavily loaded with iron rails as fast as the cement would bear them; and by this means the additional height was safely reached, the vibration of the walls being completely stopped. Heavy stone and iron curbs for chimneys are not so generally placed upon chimney tops as formerly. It is commonly thought that these finishing touches were intended for ornament only; but, according to the foregoing statements, there may have been more reason for them than has been generally supposed.

CEDAR FOR BREWER'S VATS.— The New York correspondent of the *Northwestern Lumberman*, writing of the cedar of the celebrated Dismal Swamp, says that years ago it was brought to the attention of brewers, and now the tanks and vats in these establishments are constructed almost exclusively of this material. Over 1,000,000 feet are now consumed annually in this line in New York City and its vicinity. As there is no tannic acid or resin in the wood it is peculiarly adapted for such a purpose. Long-continued experiments, with different woods, has proved that white cedar is the best. Oak abounds in tannic acid, and pine with resin. It has also been found that cedar has a wonderful durability. Growing in swampy districts, it seems inured to the effects of moisture, and will last for an incredible period without developing any tendency to warp or open. Tanks have been in use thirty years, and remain as good as ever. It has been used in this country for many years, but is now finding its way to Europe, and during the past year something like 100,000 feet have been sent to England for vats. The conservative brewers of the old country have been slow to test the worth of this wood, but when they do a brief trial is sufficient, and the cedar is adopted. A recent controversy in the European journals in regard to wood for vats and tanks has brought it more prominently than ever to the front on that side of the water, and it will most likely be more extensively used. There being but little waste in its manufacture, it can be sold at a much less price than pine tub plank. The price here has been $35 a thousand for the ordinary lengths and dimensions. Tanks and vats are constructed of various dimensions from 8 to 25 feet in height, so that the wood is cut in even lengths, 8, 10, 12 feet and so on up to the length required. Special lengths are made for special cases, and these come mostly in odd numbers. A lot was got out a few months ago 11 feet long. The logs were cut especially for it. Ordinarily the length is not over 20 feet. The thickness is 2, 2½, and 3 inches, and the width 6 to 8 inches. In small tanks the 2-inch material is used, and less than 6 inches wide is all right. For the large ones 3 inches and the larger widths are used. There is an order in now for 17,000 feet of 3-inch stuff for a tank 25 feet high. Lumber was recently furnished for a New York City brewery for a 20-foot vat requiring 60,000 feet.

A TIDE-WATER PUMP.— When Balboa discovered the Pacific he stood knee-deep in the placid waters at Panama, and the name given the great ocean was appropriate to the locality. As far north as California, however, it is a misnomer, for the waves of that ocean are there large all the summer, owing to the prevailing strong winds, and the winter storms off shore and near shore create large rollers constantly. It is now proposed to utilize this movement of the sea along that coast Interesting experiments are being carried on at the beach near San Francisco, north of the Cliff House, with that view, it being the ultimate object to supply the city with some fifty thousand or sixty thousand horse-power for industrial purposes, water being used instead of steam. The experiments are being carried out by a local engineer. The idea is to raise sea-water through the medium of a pump operated by the waves, to a height of about 350 feet, whence it can be directed into the city and the power used for elevators, mills, manufactories, etc. The apparatus used is described as exceedingly simple. A bridge has been built across a chasm into which the waves roll, and from the bridge is suspended a strong frame carrying a swinging-arm or lever, the lower end of which carries a float or paddle immersed in the water.

This lever or arm has its upper end suitably connected by rods that extend to a heavy crosshead. The lever is thirty-two feet long. The crosshead is connected with the plunger of a pump of twelve inches diameter and thirteen feet stroke. The pump is twenty-four feet above low-water level. As the lower arm of the lever moves to and fro with the action of the waves, it operates the pump, drawing the water from the sea and forcing it to the reservoir on the hill. The float on the submerged end of the lever is intended to be only about one foot under water. It is not placed in the long rollers, but works in the water inside the first line of breakers, so that it obtains the force which dashes the waves against the rocks. The operating-lever swings on the arc of a circle and can readily be withdrawn from the water as occasion demands, the power required to do this being furnished by a water-wheel. It is intended, provided the experiments are satisfactory, to establish a line of these pumps and levers. Other pumps of sixteen or seventeen feet stroke will be put up. Full stroke is seldom taken, the great length being given to provide for emergencies, so as not to break the pumps. At present the latter are pumping through pressure-valve and meter to determine the power. The force of the waves to the square foot is very large, and those engaged in the enterprise are of opinion that storm waves will not seriously affect the motion. The high tides are said to make no difference either. The pumps, it may be stated, are placed horizontally.— *Boston Transcript.*

Herr Krupp's Wealth. — The official income-tax returns just published show that the man who is rated highest in all Prussia is Herr Krupp, of Essen. His income is assessed at more than 5,000,000 marks, or £250,000, on which he pays 151,200 marks, or £7,560 annually. Next comes Baron Rothschild, of Frankfort-on-the-Main, with an income of 2,750,000, paying a tax of 81,000 marks, or £4,050 per annum. Then follows the British Consul-general, Baron Bleichröder, of Berlin, with an income of about 2,340,000 marks, paying an annual tax of 68,400 marks, or £3,420. The two next richest men in Prussia are two Silesian iron-masters. The only other Prussians with an income of over 1,000,000 marks are Baron Hausemann and a Westphalian magnate, each of whom pays rather more than £1,500 a year to the treasury. — *London Daily Telegraph.*

A Remarkable Dog Story. — John Templeton is a blacksmith who owns a fine specimen of the English mastiff. Last week Mr. Templeton was working at his forge, putting a new steel in a pick. The new steel was slightly burned in the heating, and, instead of welding, flew in half a dozen pieces. One piece struck the blacksmith just above the right eye with such force as to fasten itself in firmly. The blacksmith staggered and fell backward. How long he was unconscious he does not know, but when he revived the dog lay almost in the middle of the shop crying almost like a human being, and rubbing his jaws in the dust of the floor. The piece of steel that had struck Mr. Templeton lay a short distance from the dog. The faithful brute had seized the hot steel with his teeth and drawn it from the frontal bone of Mr. Templeton's head. The dog's mouth was found to be badly burned. — *Albany Journal.*

Diverting the Oxus to the Caspian. — The Tiflis authorities are much interested just now in the question of diverting the Oxus to the Caspian, an idea of Peter the Great, which has often been recommended of late years, but without entering upon a practical stage until recently. In the present form of the project it is proposed to cut the bank of the Oxus near the new railway station at Chardjui, and carry the water through a series of old river cuttings, across the Transcaspian desert to Balkan Bay. The advocates of the scheme state that it would be possible to do this without impairing the water supply at Khiva, whose very existence depends upon the irrigation-canals running out from the Oxus; and, moreover, in sufficient volume to enable the waterway to be navigated by steamers. The official newspaper *Kavkaz* has taken up the idea warmly, and published numerous articles, based on the latest surveys in support of it. The adverse decision of a commission appointed some years ago, when the idea of diverting the Oxus just above Khiva was mooted, does not, according to its view, affect the present issue. That commission traversed ground quite different from that at present contemplated, and which, moreover, was handicapped by the depression of the Sari Kamish, into which the commission reported the Oxus would flow without filling it up, and simply create another Aral Sea closer to the Caspian. In the present instance the construction of the railway from the Caspian to the Oxus has furnished a series of levels throughout, demonstrating that south of the watershed, between Sari Kamish and the railway, the ground is most favorably adapted for a waterway. Associated with the project is the construction of intermediate oases, for the cultivation of cotton, and the establishment of storage-reservoirs for water. In the autumn there are heavy falls of rain, and in the spring abundance of water from melted snow, both of which are at present allowed to disappear in the sands. By improving upon the methods of storage long in use among the Turcomans, it would be possible to form a large area of cultivated territory which, in time, would increase still further with the growth of vegetation, sheltering the fields and the reservoirs from the rays of the summer sun. In this manner the success of the waterway would not be dependent upon shipping only. Even if the scheme failed in this respect, it would be successful in opening up to cultivation large stretches of fertile clayey soil, which are simply deserts to-day, because there is no water to irrigate them in summer.— *Engineering.*

Connecticut Lava Beds. — The repeated earthquake-shocks in the Western States, considered in connection with the destructively severe ones last August and September, make one wonder sometimes if Connecticut will always escape with as light a shaking up as it received when the city of Charleston was so nearly destroyed. But if there is no present danger from earthquakes and volcanic eruptions in Connecticut, the time is not so very distant, geologically speaking, when the city of Hartford, had it existed, would have been in danger of being flooded with lava. It was some time before the Connecticut Valley was peopled with red men, and about the time it was settled with red mud; it was when those great birds, thirty or forty feet high, and weighing 800 to 1,000 pounds, were stalking about in the mud at Portland, that a great rent was made in the crust of the earth up and down the Connecticut Valley, and streams of lava poured out. One of these fissures made its appearance within a few miles of Hartford, at Talcott Mountain, and the cooled lava now forms the solid foundation of that pleasant summer resort. Another outpour occurred near Meriden, and the cliffs there are what remains of this solidified ebullition after the glaciers have acted upon it. The east and west rocks of New Haven are the outcome of this same eruption, and just over the line Mount Tom and Mount Holyoke belong to the same family of fiery mountains, as also do the Palisades on the Hudson. It would appear that these lava eruptions in Connecticut were of comparatively short duration, and that the force that caused the earth to crack open up and down the valley in nearly a straight line, suddenly ceased to act and the fissures closed up again. Great as must have been the forces exerted, and vast as must have been the amount of lava forced out, yet these mountains of melted rock, here in Connecticut sink into insignificance when compared with a bed of lava in the northwestern part of this country. There the sheet of lava spreads out over the country from 2,000 to 4,000 feet thick. It covers not only the whole of Idaho, but most of Oregon and Washington Territory, and portions of Nevada, California, and Montana. Incredible as it almost seems, this great sheet, so many feet thick, spreads over an area of country nearly forty times as large as the whole State of Connecticut. All the Grand Army people who returned from California last fall, over the Northern Pacific Railroad, passed through a cañon several thousand feet deep, worn through this frozen sea of lava by the Columbia River. Much as Connecticut has to boast of, in owning some of the first dry land that was ever created, and which has since never been covered by water, and settled and solid as it now appears, covered with a coating of snow and ice, still in comparatively modern times it was in a very unsettled condition and on the point of boiling over its borders.— *Hartford Evening Post.*

TRADE SURVEYS

The productive agencies of the country will be very fully engaged from the beginning to the close of the season. Prices have come to a halt in their upward course. Stocks of merchandise and material are moderate. Orders are crowding in for future attention. Manufacturers and jobbers are entering into engagements conditionally, *i.e.*, prices to be fixed at or near date of delivery. Coal, iron, steel, lumber, petroleum, tools, engines, building-material, are all firm in price. Prices, comparing figures for five years past, have been steadily declining. Anthracite coal, 22 per cent at competative points; lumber, 10 per cent; building-material 5 to 10 per cent. Iron and steel have advanced, within six months, from 10 to 50 per cent, steel rails representing the latter advance. Engines and boilers and tools and shop and mill equipments remain where they have been, except for patented improvements and modifications. The facts presented by the various industries do not admit of easy tabulation, and therefore conclusions suitable to one or two or more do not apply to all. The most unexpected is most likely to happen. Had it been foreseen, six months ago, that the enormous production of the past few months would take place, predictions of depression, over-production, and demoralized prices would have been accepted. On every hand production has been expanded. Locomotive making from a 1,500 basis to 2,000. Car-building has been increased fully 33 per cent. Iron-making has been increased 8,000 tons crude per week since January 1, and rolling-capacity is being expanded as fast as overcrowded foundries can turn out rolls. Bessemer capacity has been increased at the rate of 15 to 20 within six months, and so all through. The carriage and wagon makers have been, and now are, heavy buyers of lumber, steel, etc. The tool and agricultural-implement manufacturers have rushed in orders for material which, for some kinds, will last until July 1. Building-material is steady. Bricks may possibly advance, as it is given out that the supply at some points, viz., New York, Philadelphia and Chicago, will run short. This is altogether speculative. The stocks are very low and the prospective demand certainly heavy and sufficient to stimulate the most active efforts. Employers are making rapid progress in organization. They are presenting a bolder front to labor than they did or could last year. The leaders who see the disastrous termination of strikes have very sensibly been calling a halt, and are advising efforts of a different nature. Organized labor is looking this week to the National Labor Convention of Cincinnati where thirteen different factions have been endeavoring to mould into shape a political movement that may unite the producing interests, as they term themselves. The old greenback element predominates. This movement will act as a safety-valve to discontented labor. Wages will remain substantially where they were. Slight modifications will be made in this and that craft. The boot and shoe employers are slowly gaining vantage ground. The textile employers have held their ground well. The mill-owners in the Middle and Western States are practically free of danger from strikes. Shop-labor will prove docile. Mining-labor has effected agreements throughout the West which will avert strikes, and in the Eastern bituminous fields a 5 per cent advance will be offered, and probably accepted. From the commercial standpoint the country is in excellent condition. The railroad managers are hastening, with commendable activity, to place themselves and their rates in accord with the provisions of the new law governing rates of transportation. Just now considerable business is in suspense until freight rates are declared. Trade combinations continue to multiply for the purpose of controlling production and maintaining prices, but these combinations, while threatening much accomplish little. Financially the country is strong. The supply of currency is adequate. A slight accumulation of money showed itself lately in Boston, New York and Philadelphia, but with the re-establishment of confidence in uninterrupted industrial activity, it will re-enter the channels of trade. Small manufacturing enterprises are multiplying everywhere on the solid basis of cash earned, and not on the dangerous basis of credit. Extraordinary purchases of real estate continue to be made by long-headed investors who see that, at the present rapid rate of expansion, new territory will be in urgent demand to engage the labor, skill and enterprise of the millions who are seeking broader opportunities.